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REPORT ON WATER POLLUTION CONTROL: WILLAMETTE RIVER BASIN

Pacific Northwest River Basins Commission
Vancouver, Washington

1950

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REPORT ON WATER POLLUTION CONTROL

WILLAMETTE RIVER BASIN

1950

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REPORT ON WATER POLLUTION CONTROL

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WILLAMETTE RIVER BASIN

1950

Prepared by

Pacific Northwest Drainage Basins Office
Division of Water Pollution Control
Public Health Service, Federal Security Agency

in cooperation with

Oregon State Sanitary Authority

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TABLE OF CONTENTS

WILLAMETTE RIVER BASIN REPORT

Page No.

Introduction - 1
Acknowledgment - 3
Summary - 4
Conclusions - 9
Recommendations - 12
Historical Background - - - - - - - - - - - - - - - - - - 17
Physical Description - - - - - - - - - - - - - - - - - - - 19
    Geography - 19
    Topography - 19
    Climate - 21
    Hydrology - 22
Economic Development - - - - - - - - - - - - - - - - - - - 23
    Land Uses and Resources - - - - - - - - - - - - - - - 23
    Population - 24
    Logging - 26
    Agriculture - 28
    Manufacturing - 29
    Recreation - 31
Uses of Water Resources - - - - - - - - - - - - - - - - - 33
    Municipal Water Supply - - - - - - - - - - - - - - - 35
    Industrial Water Supply - - - - - - - - - - - - - - - 40

TABLE OF CONTENTS (Continued)

Page No.

Uses of Water Resources (Continued)

Agriculture - 42

Fishery - 43

Recreation - 46

Navigation - 47

Hydroelectric Power - - - - - - - - - - - - - - - - 48

Wildlife - 49

Pollution Contributed To Water Resources - - - - - - - 50

Damages to Water Resources from Pollution - - - - - - 59

Public Health - - - - - - - - - - - - - - - - - - - 60

Public Water Supply - - - - - - - - - - - - - - - - 63

Fishery - 67

Navigation - 71

Recreation - 71

Property - 73

Benefits Resulting from Pollution Prevention and Abatement - 74

Pollution Abatement Measures in Effect - - - - - - - - 78

Pollution Prevention Measures Required - - - - - - - - 90

TABLE OF CONTENTS (Continued)

MAPS

No.		Page No.
1	General Reference Map - - - - - - - - - - -	Following 107
2	Water Resources Developments - - - - - - -	" 107
3	Existing Primary Water Uses - - - - - - -	" 107
4	Present Stream Status - - - - - - - - - - -	" 107
5	Sources of Municipal Pollution and Existing Treatment Facilities - - - - -	" 107
6	Sources of Industrial Pollution and Existing Treatment Facilities - - - - -	" 107
7	Municipal Waste Treatment Needs - - - - -	" 107
8	Industrial Pollution Abatement Needs - - -	" 107

TABLES

A	Sources of Pollution--Municipal - - - - - - - - - -	56
B	Sources of Pollution--Industrial - - - - - - - - - -	56
C	Existing Treatment Facilities--Municipal - - - - -	80
D	Existing Treatment Facilities--Industrial - - - -	82
E	Adequacy of Existing Treatment Facilities--Municipal -	85
F	Adequacy of Existing Treatment Facilities--Industrial - - - - - - - - - - - - - - - - - - -	86
G	Progress in Construction of Pollution Abatement Facilities - - - - - - - - - - - - - - - - - - -	87
H	Waste Treatment Needs--Municipal - - - - - - - - - -	93
I	Industrial Waste Pollution Abatement Needs - - - -	94
J	Current Status of Municipal Action on Pollution Abatement Needs - - - - - - - - - - - - - - - - -	96

TABLE OF CONTENTS (Continued)

TABLES (Continued)

No.		Page No.
K	Current Status of Industrial Action on Pollution Abatement Needs	97
L	Municipalities and Industries Needing Improvements for Abatement of Pollution	98
M	Municipalities Needing Both Sewers and Sewage Treatment Plants	102

PLATES

1	Where Pollutional Discharges Originate	Following	52
2	Soil Erosion on Cultivated Land	"	58
3	Bacterial Pollution of Willamette River	"	63
4	Willamette River Oxygen Block	"	69
5	Dissolved Oxygen in Willamette River	"	77
6	Dissolved Oxygen in Willamette River	"	77
7	Sewage Treatment Facilities for Urban Populations	"	79
8	Industrial Waste Disposal	"	82
9	Municipal Sewage Treatment Program	"	95

TABLE OF CONTENTS (Continued)

APPENDIX 9

Appendix Page No.

Sec. 1 Summary of Oregon State Water Pollution Control Legislation - - - - - - - - - - - - 1
Sec. 2 City of Portland--Waterworks - - - - - - - - - 7
Sec. 3 City of Salem--Waterworks - - - - - - - - - - - 14
Sec. 4 City of Eugene--Waterworks - - - - - - - - - - 20
Sec. 5 City of Springfield--Waterworks - - - - - - - - 26
Table 1 Basic Data on Sources of Municipal Pollution 31
" 2 Basic Data on Sources of Industrial Pollution - 37
" 3 Physical Characteristics of Willamette River 48
" 4 Physical Characteristics of Main Tributaries 49
" 5 Climatological Data - - - - - - - - - - - - - - - 50
" 6 Critical Months Stream Flow - - - - - - - - - - 51
" 7 Critical Months Stream Flow - - - - - - - - - - 52
" 8 Stream Flow Characteristics - - - - - - - - - - 53
" 9 Land Distribution by Use - - - - - - - - - - - 54
" 10 Public Lands and Reservations - - - - - - - - 54
" 11 Agricultural Resources - - - - - - - - - - - - 55
" 12 Gross Farm Income - - - - - - - - - - - - - - 55
" 13 Population Distribution and Trend - - - - - 56
" 14 Industrial Distribution of Employed Persons - 57
" 15 Unreserved Saw Timber - - - - - - - - - - - - 58
" 16 Lumber Production - - - - - - - - - - - - - - - 58
" 17 Manufacturing - - - - - - - - - - - - - - - - - 59

TABLE OF CONTENTS (Continued)

APPENDIX 9 (Continued)

[illegible] Appendix Page No.

Table 18 Municipal Waterworks - - - - - - - - - - - - - 60

" 19 Industrial Waterworks - - - - - - - - - - - - - - 65

" 20 Irrigation Water Supply - - - - - - - - - - - - 71

" 21 Hydroelectric Power Projects - - - - - - - - - 72

Comments of State and Federal Agencies Upon Review of Preliminary Draft Copy of Willamette River Basin Report:

Oregon State Sanitary Authority - - - - - - - - 73

Fish and Wildlife Service, Department of the Interior - - - - - - - - - - - - - - - - - 74

Bureau of Reclamation, Department of the Interior - - - - - - - - - - - - - - - - - - 76

Corps of Engineers, Department of the Army - 78

Soil Conservation Service, Department of Agriculture - - - - - - - - - - - - - - - - - 80

INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June 1948, requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

In developing these programs, due regard must be given to improvements necessary to conserve the Nation's waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, and other legitimate uses.

Recognizing the fact that full technical information was not available to permit the development of such comprehensive programs immediately for most of the Nation's waters, the Public Health Service envisioned the development of a series of reports to cover the interim period prior to the development of comprehensive water pollution control programs. The first of these reports were the Summary Reports which were prepared for the 15 major drainage basins of the country on the basis of information readily available as of July 1, 1950. The second group of reports of this series, of which this is one, are reports on several sub-basins of the country's major drainage basin areas. Since development of comprehensive water pollution control programs is to proceed as rapidly as conditions permit, only a limited number of these interim sub-basin reports are to be completed and the majority of these will be for interstate sub-basin areas. These reports are based on data available as of December 31, 1950, and will provide a reference point for measuring progress; provide a guide to needed additional data, provide a basis for the logical development of comprehensive programs; provide a basis for approval of loans to States, interstate agencies and municipalities at such time as the Congress makes available funds for this purpose; and serve to inform the public on the water pollution control problem and needs for the sub-basin concerned.

The data on which this sub-basin report is based have been compiled through and in cooperation with the Oregon State Sanitary Authority, but should not be considered a detailed engineering investigation of the Willamette River Basin. Through this cooperating agency additional data have been obtained from other State officials, county and city officials and representatives of industry. Federal agencies also have been of great assistance.

The sub-basin reports present information about the ways the water resources of the area are used, the pollution entering those water resources and the resulting damages, the benefits which may result from pollution prevention and abatement, pollution prevention measures now in effect, and those which appear to be needed.

Since the sub-basin reports are based on data which are presently available, they do not discuss the present and future best uses of the waters of the sub-basin as such uses are related to pollution control. Such considerations will be included as a part of the comprehensive water pollution programs which will be developed later.

The deficiencies in data and the gaps in information indicated in these sub-basin reports are as significant as the presentation of available facts and statistics. They indicate the work that still needs to be accomplished by water pollution control authorities for the preparation of comprehensive programs.

Data and knowledge now available are sufficient, however, to permit the immediate solution of many of the pollution problems within the Willamette River Basin without awaiting the results of additional surveys and studies.

A sincere effort has been made by all who contributed to this report to present a fair picture of the complex water pollution problems in the Willamette River Basin.

ACKNOWLEDGMENTS

The Public Health Service wishes to acknowledge the cooperation and assistance of those agencies and individuals who have contributed to the preparation of this report.

The Oregon State Sanitary Authority furnished the basic information and actively cooperated in the preparation of this report. Through the Sanitary Authority, other State agencies, such as the Oregon State Game and Fish Commissions, the Board of Health, Department of Agriculture and Oregon State College, furnished valuable data and assistance.

Federal agencies from which assistance was obtained include: the Corps of Engineers, Department of the Army; the Bureau of Reclamation, Fish and Wildlife Service, and Geological Survey, Department of Interior; and the Soil Conservation Service and Forest Service, Department of Agriculture.

SUMMARY

The Willamette River Basin has a total drainage area of 11,200 square miles, all lying within the State of Oregon. This is the most heavily populated sub-basin of the Columbia River drainage basin. Its 1950 population of 873,000 represents a 48 percent increase during the past decade. Industrial activity centers about the utilization of timber, soil, and water resources.

Forests cover 62 percent of the basin area, and will provide for a sustained annual yield of about 1.7 billion board feet of timber. Thirty thousand farms, that cover 2 million acres, produce 100 million dollars worth of crops per year. Scenic areas, fish and wildlife, and facilities for recreation make the tourist business the third largest source of income for the State. No exact figures, however, are available for the Willamette Basin alone.

Economic development has progressed favorably, largely because of the readily available water resources. These water resources are used extensively for the following purposes:

1. Sources of water supply -- domestic, industrial, irrigation and livestock.
2. Propagation of fish -- game and commercial.
3. Recreation -- fishing, hunting, swimming, boating, camping, picnicking, and winter sports.
4. Navigation.
5. Hydroelectric power production.
6. Wildlife.

Municipalities and industries make extensive use of these resources for domestic and processing needs. It is estimated that 380 million gallons of water are required to meet an average summer day's demand for municipal and industrial purposes. Of this total 349 million gallons are obtained from surface sources and 31 million gallons from ground water sources.

The major sources of pollution of the Willamette River and its tributaries are the discharge of sewage and wastes from 52 municipalities and some 83 industries. These include the raw sewage from a population of 441,050, the treated sewage from a population of 47,400, and the wastes from 6 pulp mills and 77 other industries with separate outlets, and 150 industries connected to municipal sewers. The population equivalent of known organic wastes discharged from all of these sources is about 4,000,000. The organic waste load from 17 industrial sources with separate outlets and 14 industries connected to the municipal sewers are undetermined. The types and characteristics of wastes discharged from 6 other industrial sources also are undetermined.

Further surveys are needed to determine the volume and strength of these unknown wastes, as well as wastes from a number of industries in the Portland Harbor area of the lower Willamette River. Moreover, steps should be taken to locate and evaluate the pollution caused by gravel mining and logging operations.

Pollution exerts damaging effects on all water uses in the main Willamette River and the lower stretches of certain tributaries. It is particularly damaging to the basin's fishery resources, to various recreational uses, to property values, and to public and domestic water supplies. Wastes from food and vegetable processing plants, pulp and paper mills, and municipalities, create an oxygen depletion zone in the lower Willamette River during the summer and fall months which obstructs migratory fish from reaching and returning from valuable upstream spawning areas. Untreated sewage discharged by 19 municipalities creates unsatisfactory bacterial conditions in the Willamette River below Cottage Grove, and in the lower stretches of Long Tom, Calapooya, Santiam, Yamhill, Molalla, and Clackamas Rivers, and Rickreall Creek. Inadequately treated sewage discharged into Pudding and Tualatin Rivers and Johnson Creek, also creates unsatisfactory bacterial conditions.

The release of stored waters from existing reservoirs, and those now under construction or proposed, will increase the flow in the Willamette River during the critical summer and fall months. Although this will have a beneficial effect on the water quality in the main river, it will not be sufficient to permit full use of these waters for planned developments of the fishery resources, recreational areas, and public water supplies; and for new industries. Such increased summer and fall flows must be considered as a supplement to, and not a substitute for, treatment of municipal sewage and industrial wastes.

Municipal sewage treatment works now serve about 10 percent of the total sewered population of 488,450. Thirty-three of the 52 municipalities having sewerage systems treat their wastes prior to discharge. However, some of these existing treatment plants have become obsolete or overloaded during recent years. Twenty-two treatment plants which serve 23 of the municipalities are adequate to handle the sewage from the present population. Three of the remaining 10 require enlargement or additions and the other 7 require complete replacements.

At present 54 of the 83 industries not connected to municipal sewers have treatment facilities. Thirty-nine of these facilities provide satisfactory waste disposal methods. Thirteen of the remaining 15 are of an inadequate capacity. Adequacies of the remaining two treatment facilities are undetermined.

Present requirements for pollution prevention and abatement in the Willamette River Basin include the enlargement, replacement, or construction of new treatment facilities at 42 municipal and 29 industrial locations. The municipal program, which is estimated to cost 23.5 million dollars, will provide adequate treatment (under present conditions) for a population of 513,050 plus the industrial wastes presently being discharged into municipal sewers. This includes new treatment plants for a population of 24,600 now living in 13 unsewered communities; new treatment plants for a population of 441,150 living in 19 sewered communities without treatment facilities; and the enlargement or replacement of existing facilities for 23,100 in 10 communities.

The present industrial program estimated to cost nine million dollars includes new treatment facilities for 15 industries and the enlargement, addition to, or replacement of existing facilities for 13 other industries. In addition, one industry will be required to connect to the municipal system. The requirements of 15 other industries are undetermined.

CONCLUSIONS

1. Water resources in the Willamette River Basin are vitally important to the continued development of the area. Full usage of these resources for domestic, industrial and agricultural purposes, propagation of fish, and recreation, is dependent upon the reduction of polluting wastes now entering the streams, as well as the control of future sources of pollution.

2. Pollution is particularly severe in lower sections of the main Willamette River and certain tributary streams. In addition, indiscriminate cutting of timber from public water supply watersheds has left large areas unprotected and subject to serious erosion.

3. The major causes of pollution in the Basin are the wastes discharged by municipalities, food processing plants, and pulp and paper mills; and the silt, logs, bark, and other debris entering the streams from eroding agricultural and cut-over forest lands, and from uncontrolled logging operations.

4. Untreated domestic sewage from a population of 441,050, treated domestic sewage from a population of 47,400, together with a variety of industrial wastes, are discharged into the main stem and tributaries through municipal sewerage systems.

5. Pulp and paper mill wastes having a population equivalent of 2,901,000 and other industrial wastes with a population equivalent of 227,150 are discharged to the main stem and tributaries through separate outlets.

6. The total organic waste load discharged to the main stem and tributaries has a population equivalent of about four million.

7. Principal pollutional damages are: (a) serious impairment of present and future municipal water supplies; (b) interference with full development of fishery resources; (c) destruction of recreational areas; and (d) decreased property values.

8. Most serious damages occur during the late summer and early fall when stream flows are lowest, and wastes from seasonal food processing increase the total pollutional load. Increased stream flow during this period resulting from regulated releases from existing reservoirs, and reservoirs now under construction or proposed, will not in itself be sufficient to provide a suitable quality of water for all beneficial uses.

9. Surveys conducted since 1929 have shown that, during the late summer and early fall, bacterial contamination has been excessive in certain stretches of the main stem and tributary streams, and concentrations of dissolved oxygen in the vicinity of Portland have not been sufficient to support fish life. This oxygen deficiency has extended for a lineal distance of as much as 35 miles in some years.

10. Sufficient basic information is available and plans are going forward under the Oregon State Sanitary Authority's program for immediate construction of many sewage and waste treatment facilities. Additional data on industrial wastes, degree of treatment and water quality objectives are required to supplement the program.

11. The program of the Sanitary Authority is strongly backed by public opinion and by other State agencies concerned with development and reclamation of the Basin's water resources. Through the voluntary cooperation of municipalities and many industries, a large part of the program is already well underway.

RECOMMENDATIONS

It is recommended that:

1. In order to reduce pollution in the Willamette River Basin, 42 municipalities and 29 industries construct treatment facilities in conformance with requirements of the Oregon State Sanitary Authority as follows:

Name	Available Data On Pollutional Loads (Population Equivalent)	Project Requirement
Municipal		
1. Portland[1]	403,000	New Plant
2. Salem[1]	250,000	" "
3. Eugene	110,000	" "
4. Corvallis	40,000	" "
5. Albany	24,000	" "
6. Springfield	11,500	" "
7. Lebanon	10,000	" "
8. McMinnville	8,500	" "
9. Oregon City	8,000	" "
10. Milwaukie[1]	5,000	" "
11. Oak Grove[2]	5,000	" "
12. Cottage Grove	3,500	" "
13. Oswego	3,000	" "
14. Stayton[2]	3,000	" "
15. West Linn	2,500	" "

	Name	Available Data On Pollutional Loads (Population Equivalent)	Project Requirement
16.	Canby[2]	2,000	New Plant
17.	Cornelius[2]	2,000	" "
18.	Gladstone	2,000	" "
19.	Oakridge[2]	2,000	" "
20.	Willamina[2]	2,000	" "
21.	Mill City[2]	1,500	" "
22.	Philomath[1] [2]	1,500	" "
23.	Sandy[2]	1,500	" "
24.	Dayton[2]	1,400	" "
25.	Dunthorpe[2]	1,000	" "
26.	Tigard	1,000	" "
27.	Molalla	1,000	" "
28.	Sheridan	1,000	" "
29.	Harrisburg	800	" "
30.	Yamhill[2]	700	" "
31.	Brownsville	500	" "
32.	Monroe	300	" "
33.	Forest Grove	30,000	Replace Existing Plant
34.	Dallas[1]	6,100	" " "
35.	Mt. Angel	3,500	" " "
36.	Woodburn	2,000	" " "
37.	Carlton	850	" " "

	Name	Available Data On Pollutional Loads (Population Equivalent)	Project Requirement
38.	Woodburn School	500	Replace Existing Plant
39.	Vermont Hills	350	" " "
40.	Gresham	12,000	Enlarge Existing Plant
41.	Hillsboro	7,500	" " "
42.	Cedar Mill Park	1,600	" " "
	TOTAL MUNICIPAL	973,600	
Industries			
1.	Oregon Pulp & Paper, Salem	860,000	New Plant
2.	Crown Willamette, West Linn	831,000	" "
3.	Publisher Paper Co., Oregon City	556,000	" "
4.	Spaulding Pulp & Paper Co., Newberg	495,000	" "
5.	Crown Willamette, Lebanon	109,000	" "
6.	Mt. Angel Flax Growers, Mt. Angel	6,000	" "
7.	Volney Felt Mills, Portland	6,000	" "
8.	Nebergall Meat Co., Albany	5,600	" "
9.	Pacific Roofing Co., Portland	2,800	" "
10.	Bodle Co., Banks	Unknown	" "

	Name	Available Data On Pollutional Loads (Population Equivalent)	Project Requirement
11.	Eugene Chemical Co., Eugene	Unknown	New Plant
12.	Alpenrose Dairy, Vermont Hills	"	" "
13.	Fulton Park Dairy, Vermont Hills	"	" "
14.	Brownsville Mills, Brownsville	"	" "
15.	General Foods, Inc., Woodburn	50,000	Enlarge Existing Plant
16.	Oregon Turkey Growers, Eugene	3,600	" " "
17.	Mayberry Chapman Meat Co., Eugene	1,680	" " "
18.	Irish McBroom Meat Co., Eugene	1,680	" " "
19.	Benton County Flax Growers, Monroe	Unknown	" " "
20.	McKenzie Meat Co., Springfield	460	Additions to Existing Plant
21.	Forest Fiber Products, Gaston	30,000	Replace Existing Plant
22.	H. N. Kumner Meat Co., Hillsboro	2,100	" " "
23.	Steen Bros., Albany	1,450	" " "
24.	M. & S. Cannery, Milwaukie	570	" " "
25.	Albany Foods, Inc. Albany	100	" " "
26.	Portland Gas & Coke Co., Portland	Unknown	" " "

	Name	Available Data On Pollutional Loads (Population Equivalent)	Project Requirement
27.	Kelly Farquhar Co., Banks	Unknown	Replace Existing Plant
28.	Borden Co., Albany	1,000	Connect to City Sewer
29.	Ried Murdock Co., Salem	32,500	Connect to City Sewer
	TOTAL INDUSTRIAL	2,996,540	
	GRAND TOTAL	3,970,140	

1/ Plants now under construction.
2/ Presently unsewered communities.

2. Erosion control measures be required on all public water supply watersheds during and after timber cutting operations.

3. Surveys for determining the sources, characteristics and amounts of industrial wastes discharged into public waters be completed as rapidly as possible.

4. Desirable water quality objectives for all uses be determined and adopted by the Oregon State Sanitary Authority.

5. In order to assure compliance with the Sanitary Authority's policy of permitting no new domestic sewage or industrial wastes to enter the basin's waters, the water pollution control laws of the State be amended to include a permit requirement clause. Also, that the State water pollution control laws be further amended to include a penalty clause.

6. In order to be able to make greatest possible use of regulated stream flows, all water resource developments in the basin be effectively coordinated between both State and Federal agencies.

HISTORICAL BACKGROUND[1]

After traversing the dry, dusty stretches of prairie and sagebrush of the Upper Great Plains region, immigrants to the Pacific Northwest gazed with awe and renewed spirits at the lush verdure of the broad Willamette River Valley. By 1841, the Oregon Trail had served well the passage of many people coming from the Mississippi River and beyond to seek their fortunes in the Willamette and other green valleys of the Pacific Northwest. Following an immigration lull during the gold rush in neighboring California, it picked up again when congressional action in 1850 offered a square mile of free land to each Willamette Valley settler. Within five years practically all desirable land had been claimed.

Markets in the California and Southern Oregon gold fields took all the farm produce grown by wives and children of men who went to prospect for the precious metal. Agriculture became a prosperous business. The ready gold from mining and farm prosperity was the starting point of small basic industries that prepared the way for modern development of the Willamette Valley.

On the flip of a coin, the growing river mouth city became Portland instead of Boston. Within twenty years villages and towns sprang up along the river and its tributaries. Railroads came through the mountain-passes from San Francisco and

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1/ Parrish, P. H. Historic Oregon. The MacMillan Company. New York. 1937.

opened markets that softened the blow of the failing gold boom. With these new dependable markets to the south and others up the Columbia to the east, there emerged a healthy economy based upon fertile lands, great stands of timber and abundant clean water.

PHYSICAL DESCRIPTION

Geography

The Willamette River Basin[1] is a rectangular drainage trough 150 miles long and about 75 miles wide, lying between the Cascade and Coast Ranges in northwestern Oregon. The run-off from its 11,200 square miles of mountain slopes, gentle hills, and level fertile plains flows northward to the Columbia River near Portland.

Topography

The Willamette valley floor is located somewhat west of the center of the valley with the sides sloping upward to foothills and finally to rugged mountains on the east, south and west. The valley, 3,500 square miles in area, extends from Eugene almost to the mouth of the river. Most of the valley lies below an elevation of 500 feet, mean sea level.

To the west, the ridges of the Coast Range reach elevations of 3,000 to 4,000 feet; to the south, the Calapooya Mountains reach 5,000 feet; while peaks in the Cascade Range exceed 10,000 feet.

The Willamette River, which is fourth in volume of flow among the tributaries of the Columbia River, has its origin at the confluence of its Coast and Middle Forks above Eugene[2]

---

[1] See Map No. 1.

[2] See Appendix 9 -- Table 3.

From this point, about 435 feet in elevation above the Columbia River, the Willamette meanders northward for 188 miles through the fertile farmlands of the western half of the basin. The Willamette River passes over the Keizer and Windsor Island Rapids below Salem, and Willamette Falls at Oregon City, dropping 47.45 feet before joining the Columbia River about 10 miles below Portland.

From Oregon City to its mouth, a distance of about 26 miles, the Willamette River is subject to tidal fluctuations, and is affected by backwater from the Columbia River during high stages on the latter river. At the junction with the Columbia River, stage fluctuations over a 43-year period have varied between 0.8 and 33 feet above mean sea level.

Many tributaries, that range in size from prominent rivers to small mountain streams, flow swiftly down the wooded mountainsides and then meander more slowly across the valley floor to the Willamette.[1] The tributaries on the west drain the slopes of the Coast Range, and those on the east originate in the Cascades. The headwaters of the majority of west side tributaries originate at elevations of 1,000 to 2,900 feet, while those on the east rise in the Cascade Range at elevations of 6,000 feet or more. Some of the major streams are more than 80 miles long.

Waldo Lake is the only natural lake of appreciable size and is perched high in the mountains near the southeastern corner of the basin. Along the southwestern edge of the basin, Fern Ridge, Cottage Grove, and Dorena Reservoirs have been constructed for flood control, and to facilitate navigation and irrigation. Two additional multiple-purpose reservoirs are now under construction on tributary streams. Although there are a few small natural lakes in the area, the waters of these reservoirs will have tremendous recreational appeal.

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[1] See Appendix 9 -- Table 4.

Climate[1]

The attractive climate of the Willamette area is an important factor in the rapid economic and cultural development that stretches along the river from Eugene to Portland. Outdoor work is possible at many places throughout the year, and the average growing season in agricultural areas varies from 150 to more than 200 days. Summers are dry and moderately warm while winters are mild though wet. The usual absence of ice cover in winter makes navigation and towing of logs possible at all seasons.

Temperature variation between summer and winter is small on the valley floor. Average temperatures range from about 40 degrees F., in January to about 67 degrees in July, while the annual recorded mean varies from 48.9 to 53.1 degrees F. Temperatures below zero are rare, and seldom is it warmer than 100 degrees F., in the middle of summer. In the mountains, of course, it is cold enough to keep some peaks covered with snow throughout the year. The white spires of several peaks in the Cascade Range are visible from the valley.

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[1] See Appendix 9 -- Table 5.

The period November through February is the rainy season during which about 60 percent of the annual precipitation occurs. Precipitation varies greatly between mountain and valley regions. It exceeds 140 inches annually over small areas in the Coast Range, and is more than 120 inches over parts of the Cascades. The annual average on the Willamette Valley plain is 40 inches, and this decreases to 30 inches near the center of the valley floor. In the mountain areas above 7,000 feet, three-fourths of the precipitation falls as snow, whereas only 2 percent falls as snow on the valley floor and then melts away very rapidly.

Hydrology[1]

During the months of November through April, maximum flows occur in the Willamette River and its tributaries owing to intermittent but frequent precipitation and the melting of mountain snow. Rapid runoff over unfrozen ground makes the water muddy, and damaging floods are not infrequent. Minimum flows occur between July and October during and following prolonged periods of little or no rainfall. Summer temperatures and the seasonal addition of food processing and other polluting wastes to those discharged uniformly throughout the year combine with the low flows to make this the period of poorest stream condition.

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[1] See Appendix 9 -- Tables 6-8.

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ECONOMIC DEVELOPMENT

Land Uses and Resources

Economic development in the Willamette Basin has progressed at a faster rate than elsewhere in the State. Major resources responsible for this are large stands of timber, highly fertile soil areas, access to cheap hydroelectric power, an excellent sea port, congenial climate, and scenic areas with abundant fish and wildlife for recreational use. Continued development of these natural resources is imperative for the economic growth of the Pacific Northwest and important to the entire nation. Economic and other advantages have attracted two-thirds of the State's total population to this relatively small basin.

Flanking the centrally located agricultural lands and continuing up the mountain slopes, stands of merchantable timber cover more than half the basin.1/ Some of the Nation's largest remaining inventories of old-growth saw timber are in these forests. Most of it is highly prized Douglas fir. National Forests, which occupy the greater part of the basin's public lands, spread their 2-1/4 million acres around the rim of the basin.2/

The main stem of the Willamette flows through agricultural lands which extend outward to the foothills.3/ Although these lands occupy

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1/ See Appendix 9 -- Table 9.

2/ See Appendix 9 -- Table 10.

3/ See Appendix 9 -- Table 11.

less than one-third of the basin, or about 2 million acres, their productivity gives them great economic importance. Farm products of all kinds raised in 1944 had a market value of more than 100 million dollars--41 percent of the total for the State.[1] Owing to the lack of unoccupied and undeveloped agricultural lands, improved methods of farming and extension of irrigation practice are required to meet the needs of expanding agricultural economy.

Population[2]

The population of the Willamette basin is predominatly urban with approximately one-half the people living in the cities of Portland, Salem, and Eugene. Outside these metropolitan centers, the population is well distributed in smaller cities, towns, and farms along the river and outward to the edge of the valley floor.

Since 1900, population growth has been rapid under the impetus of new economic opportunity in the development of agricultural, forest, and water resources. Feverish activity during the war years in shipbuilding, lumbering, and manufacturing drew manpower from all parts of the country and raised the population approximately 48 percent since 1940. Even the closure of war plants, and expected readjustments in the booming timber and food industries after 1945, failed to discourage people coming to seek

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[1] See Appendix 9 -- Table 12.

[2] See Appendix 9 -- Table 13.

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employment and a new home in the Willamette Basin. With the growth of new business enterprises, and the expanding lumber and forest products industry, population may be expected to grow for some time in the future. The 1950 population of the basin was about 873,000.

Demands upon the water resources will grow with the population. The value and need of clean water for all purposes will become increasingly important. Plans are now underway for utilizing the power and excess volume flows of the Willamette system for the benefit and economic advantage of present and future populations. Such development may well be partially governed by success of the efforts to prevent and control water pollution.

There is a closely-knit dependence of the urban processing labor force upon the timber, agricultural, and other products that result from rural labor.[1] The raising and marketing of farm products and the cutting of timber require the services of 17 percent of all employed workers--14 percent of all employed workers in agriculture alone. Twenty-two percent of the labor force is engaged in manufacturing with saw and planing mills, various wood conversions and food processing having major prominence. The remainder of the workers are employed in construction, transportation, trade, communications, utilities, professional, governmental, and other types of services.

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[1] See Appendix 9 -- Table 14.

Logging

From the outer fringe of the valley farm lands, and extending to the ridges of the surrounding mountains, stand the vast remaining forests. Extending to 3,500 feet above sea level they are mostly Douglas fir. On higher slopes much of the timber is western hemlock, balsam fir, and non-commercial varieties. Forests cover 62 percent of the basin area--4.5 million acres with 65 billion board feet of saw timber.[1] A little over half of the area is in National Forests and, therefore, subject to controlled cutting.

The timber industry of the Northwest moved into the Willamette Basin largely since 1940, and has made it the major source of logs for Columbia River mills. During the war period of 1940 to 1944, saw logs were cut at the accelerated rate of 2.5 billion board feet annually.[2] The urgent need for lumber and other wood products in the postwar construction period caused a continued upward trend in logging activity. Following a slight drop in 1946, an all-time cutting high was reached in 1947. These rates of cut are in excess of the estimated sustained yield of about 1.7 billion board feet annually.

The availability of these great forest resources had a guiding influence upon the total industrial pattern of the basin. Over and above the labor force required for the actual logging operations--as many as 9,000 in 1947--the easy access to huge supplies of raw material stimulated the establishment of many conversion plants and the attraction of new workers. These plants are of wide variety. Sawmills are most common, and extend out from the agricultural land, and even to the sites of cutting. Nine plywood plants, 6 pulp and paper mills, and numerous shingle, lumber, and finishing plants prepare the trees for markets of the world.

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[1] See Appendix 9 -- Table 15.

[2] See Appendix 9 -- Table 16.

Without doubt, the future of the industry will include restrained cutting of the forests to approach conformity with the rate of replacement, development of many new products, and still greater utilization of the parts of the tree now lost in the form of wastes. These developments will have a beneficial effect upon some of the pollution problems that now stem from the incomplete utilization of harvested forest products.

The relation of the timber cutting and conversion industry to the pollution status of Willamette Basin watercourses is sometimes obscured by the industry's great economic importance. A further factor is the fact that undesirable effects of logging on new streams in widely scattered areas are usually recognized only after the damage has been done. Pollution control officials are concerned over the destruction of public water supply watersheds, stream beds choked with slashings, bottom accumulations of bark, the dumping of sawdust, and pulp mill liquors.

Agriculture[1]

On the valley floors and lower foothill slopes, lands suited to agriculture are quite fully occupied. Any marked increase in agricultural productivity will depend upon more intense use of the farm land now available rather than development of less desirable new lands. More than one-third of the basin area, or about 2.7 million acres, is in farm ownership distributed among some 32 thousand separate farms.

These farms are intensely cultivated small units averaging 84 acres in size but varying within wide extremes. The value of farm lands and buildings was 366 million dollars in 1945. Their production is extremely diversified. In the lower Clackamas Valley near Portland, there are many poultry farms on acreages of small size. Truck farms lie along the river banks on fertile alluvial soils, and many of them are irrigated from streams or ground water supplies. On the rolling slopes and foothills are located fruit and nut farms. Owing to the high value of the good farm land, many specialty crops, such as seeds, are grown. Herds of dairy cattle are scattered widely throughout the basin with a concentration near Portland markets. Some poorly drained lands are turned to growing hay or small grains.

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[1] See Appendix 9 -- Tables 11 and 12.

Manufacturing[1/]

The Portland sea port and availability of inexpensive hydroelectric power from Columbia River plants have brought about a tremendous wartime expansion in manufacturing, particularly in the lower Willamette area. Although emergence of the basin as the major manufacturing center of the Columbia Basin was based upon the processing of forest and agricultural products, the trend since 1940 has been toward greater diversification. Much of the expansion has been in metal working, machinery, chemicals and heavy industry in which the west has long been deficient.

Attraction of new industry to the area is assured as costs of fuel oil, gas and coal, used by industry in other parts of the country, continue to mount. It is an important economic fact that the Pacific Northwest, with only 8 percent of the country's area, possesses 37 percent of its potential hydroelectric power. Further economic growth is curbed at the present time by the rate at which potential power of the Columbia Basin is harnessed and made available for high energy consuming industries.

Transportation

Economic growth of the basin, even from the early settlement period, was molded around the convenience of shipping through the tidewater port of Portland. Not only does it serve as a shipping center for the Willamette Basin but for the entire Inland

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[1/] See Appendix 9 -- Table 17.

Empire as well. Foreign-bound cargoes of wheat, lumber, and flour averaged 1.5 million tons annually in the post-war years, while inbound cargoes, mostly petroleum products, averaged 5.5 million tons. Other Willamette River traffic is characterized by log rafts and barges that serve the industrial needs of various lumber and pulp and paper mills from Oregon City to the Columbia River.

The only north-south mainline railroad through the Pacific Northwest enters the Willamette Valley from Klamath Falls, and passes through Portland, along Puget Sound, and into British Columbia. An older rail line over the Calapooya and Siskiyou Mountains, and through the picturesque Rogue River Valley, enters the head of the valley near Cottage Grove and follows the Coast Fork Willamette River to a junction with the main line at Eugene.

The well-knit highway pattern of the basin enables the producers in agricultural, forest, and manufacturing areas to truck their goods to metropolitan markets, and to water and rail terminals. A principal artery covers the length of the valley and joins with a number of highways to the seacoast on the west and through Cascade passes to the east. Most of the popular recreational areas are easily accessible.

Transcontinental and coast-wise air service connects Portland and principal cities of the Willamette River with points outside the basin. Expansion of airport facilities at Portland and other cities is following a growing patronage of this mode of travel.

Recreation

The Willamette Basin, like much of the Pacific Northwest, is an area of tremendous recreational possibilities. From the snowfields of the Cascade peaks to the valley fishing streams, the variety of outdoor attractions offer diversion and vacation opportunity to people within and outside the basin. This combination of recreational appeal and high utilization from the centers of population has resulted in a growing economic capitalization of this favorable relation. Sporting goods stores, boat builders, auto courts, hotels; manufacturers of fishing tackle, camping equipment, and other sporting goods; and resorts, service stations, and many other types of business profit from recreation. The State of Oregon annually spends about $100,000 in advertising the State's scenic attractions and recreational facilities, and the resulting tourist business is now its third largest industry, worth more than 100 million dollars a year.

Fishing, boating, swimming, camping, picnicking, or quietly enjoying the river scenery are among the more obvious recreational values of the basin's water. Water is a recreational resource whose value will grow with the population and the extension of travel and vacation facilities.

A large part of the recreational resources are on lands that belong to the people and are administered for them by various governmental agencies. In discharging their obligation of preserving these values for future generations, these agencies have developed 22 State Parks, 68 Forest Service Recreation Areas, and have set aside millions of acres in National Forests. Preservation of the water resource is equally necessary.

Spoilage of the recreational value of water by pollution already is underway. Killing of fish, closure of bathing areas, and the presence of floating wood, oil, rubbish, and garbage are evidence of unwise water uses by communities and industries alike.

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USES OF WATER RESOURCES

From the beginning of Willamette River history, rapid basin development has hinged upon the availability of tremendous water resources.[1] Although at first the river was used mainly as a path of travel and a source of salmon, dependence upon the water resources has continuously extended to many other uses. No person in the basin is now unaffected by either the supply or quality of available water.

Present uses of the basin's water resources are as follows:[2]

1. Sources of water supply--domestic, industrial, irrigation and livestock.
2. Propagation of fish--game and commercial.
3. Recreation--fishing, hunting, swimming, boating, camping, and winter sports.
4. Navigation.
5. Hydroelectric power production.
6. Wildlife.

Plans for development of the basin's water resources by the Corps of Engineers and Bureau of Reclamation include construction projects for the benefit and expansion of water uses for the above purposes. These plans include: (1) storage dams on tributary streams to be constructed primarily for flood control, irrigation, hydroelectric power, and navigation; (2) channel improvement and contraction necessary to secure regulation of flow and maintain minimum depths of 6 feet from Oregon City to the mouth of Santiam River and 5 feet thence to Albany; (3) reconstruction and enlargement of the locks at Oregon City; (4) irrigation diversion, ground water supply, pumping transmission, and distribution facilities; and (5) facilities for protection and expansion of the fishery resources. Use of areas in and around reservoirs and along streams to expand recreation, and increased minimum stream flows for water pollution control, are other features included in the basin's water resources development plans.

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[1] See Map #2.

[2] See Map #3.

A number of the projects included in the plans of these two Federal agencies have been authorized for construction. Of the 13 storage projects authorized, the Fern Ridge, Cottage Grove, and Dorena reservoirs have been constructed. Lookout Point and Detroit Dams are now under construction. Authorizations also include dams for reregulating purposes below the Lookout Point and Detroit reservoirs. Construction work is proceeding on some of the channel improvement and fishery facilities included in the basin plans. Pollution abatement in the Willamette River Basin will be necessary to obtain full value from the expenditures of funds for much of this construction.[1]

Municipal Water Supply[2]

Some 81 water systems are used to supply the domestic needs for 750,000 people living in cities, towns, water districts and institutions. In addition these 81 systems furnish water to a large number of industries for use in processing and other plant operations. The estimated demand on these water systems for clean, pure water averages 190 million gallons daily during the dry summer months.

People of Oregon like water that comes from melting mountain snow. They attach to the mountain streams an inherent quality of purity and wholesomeness unthinkable for the lower Willamette River. Tributary streams or wells are used by most of the municipalities for their water supplies. A total of 29 systems serving nearly 690,000 people use surface waters of the Willamette Basin. Only three of these, Springfield, Adair Village and Corvallis, use the Willamette River as a source of supply. All three have installed complete purification plants to treat this water for domestic use. Eugene, Albany, Forest Grove, Sweet Home and Wendling, although using tributary streams as sources of supply, also have installed complete purification plants. Lebanon has installed an up-flow coagulation and sedimentation system. The remaining systems with one exception provide only chlorination prior to use of water from their surface sources. Detroit uses untreated water from Mackey

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[1] See Map #4.

[2] See Appendix 9 -- Table 18.

Creek. The average daily use of surface waters during the dry summer months is about 175 million gallons.

Fifty-two systems serving about 60,000 people depend upon ground water supplies. The use of ground waters during the dry summer months averages about 15 million gallons daily.

Surface water supplies obtained from sources on the Cascade slopes are usually adequate as melting snow and springs maintain continuous flows in most streams. Of the systems obtaining water from the Cascades, only Portland depends upon impounded storage to maintain an adequate year-around supply. Surface water supplies obtained from streams draining the Coast Range Mountains are almost entirely dependent upon storage facilities to provide dependable supplies. Even with storage developments, a number of municipalities have experienced shortages in supply during recent years. Corvallis, serving a population of about 17,500 has had to supplement its tributary supplies by resorting to the Willamette River.

Where waters of the Willamette have been unsatisfactory for domestic use, many small urban centers have been successful in obtaining adequate ground water supplies. Others in less fortunate locations, however, can obtain water from ground sources only at great depth or by the costly operation of a number of shallow wells. All large municipalities depend upon surface sources for their water supply.

Tributary waters are by choice more attractive sources of supply than the bacterially and chemically contaminated water of

Willamette River. Growing demands for water and deforestation of unprotected watersheds are gradually rendering some tributary sources either too silt-laden for use or too limited in volume. Logging operations already have damaged the watersheds supplying the valley communities of Carlton, Oregon City, West Linn, Dallas, Molalla, Forest Grove, Silverton, Lebanon, Yamhill, Hillsboro, Sweet Home and Albany. As long as timber has a market value, cutting of uncontrolled watershed forests will continue. Such sources of water supply probably will have to be abandoned by the larger cities with the prospect of drawing upon the mainstem Willamette River for a source of supply.

Shallow wells in areas of porous deposits are subject to surface contamination. Frequently such wells have had to be abandoned temporarily during floods and disinfected before they could be placed back in operation. Some of the best aquifers are too near the surface to provide adequate protection against contamination. This was forcibly demonstrated in 1947 in the vicinity of Salem where chemical wastes from an experimental aluminum plant had been dumped into a gravel pit. These wastes, chiefly aluminum hydroxide and aluminum sulphate, invaded the ground water to a distance of about a mile and interrupted the use of many private wells in the affected area. Water which once inspired the confidence of the consumer brought forth complaints of extreme hardness, discomfort to adults from internal use and severe gastric and intestinal disorders in infants.

The foreseeable future holds the possibility of an expanding and increasingly important dependence upon Willamette River to supply the water needs of additional municipalities. In recognition of the present unsuitability of the river for such use at many points of damaging pollution, abatement is an urgent need.

The City of Portland[1/] obtains its water from the Bull Run River, which drains the Northwest slopes of Mount Hood and flows into the Sandy River. This drainage area is located outside the Willamette River Basin. Storage of 33,000 acre feet is provided in Lake Ben Morrow with a dependable yield of about 200 million gallons daily. Pipe lines with capacity of 150 m.g.d. deliver the water by gravity a distance of about 25 miles to Portland. The watershed, being located in the Mt. Hood National Forest, is restricted, and furnishes an excellent quality of clear soft water. The water is treated with chlorine and ammonia at the supply headworks. The Portland supply furnishes water for 478,000 people living in Portland and in areas served by 63 water companies and water districts which purchase water, wholesale, from the city. The average daily water consumption is about 56 million gallons and the maximum daily use about 138 million gallons.

The City of Salem[2/] obtains its water supply from the North Santiam River. The river water is first passed through infiltration galleries located on Staten Island and then flows by gravity

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[1/] See Appendix 9, Section 2.

[2/] See Appendix 9, Section 3.

about 18 miles through a 36-inch pipe line to Salem. The total capacity of the headworks system is about 31 m.g.d. The capacity of the supply line is 19 m.g.d. During certain periods of the year the river water is turbid and some fine silt passes through the infiltration gallery. The city has installed 3 wells on the Island which provide a limited quantity of clearer water during these periods. The water is treated with chlorine and ammonia near the headworks. The Salem supply furnishes water to 48,500 people living in Salem, three water districts, one town and Fairview Homes located outside the city. The average water use is about 8.86 m.g.d., and the maximum use about 19.43 m.g.d.

The City of Eugene1/ obtains its water supply from the McKenzie River about 6 miles east and north of the city. This water is first treated in a modern filtration plant and then pumped through a 45-inch pipe to the city distribution system. Raw water pumps have a capacity of 35.5 m.g.d., and the filtration plant has a capacity of 24 m.g.d. A clear well capacity of 300,000 gallons is provided at the filtration plant. Variable high service pumps have a capacity of 30 to 40.5 m.g.d. These deliver water to the distribution system through the 45-inch pipe line with an estimated capacity of 50 m.g.d. The Eugene supply furnishes water to 54,090 people living in Eugene and in areas outside served by nine water districts. The average water use is

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1/ See Appendix 9, Section 4.

about 9.94 m.g.d. and the maximum use about 21.45 m.g.d.

The City of Springfield[1] obtains its water from the Mountain States Power Company system. The present supply is taken from the Willamette River, treated by plain sand filtration and chlorination and pumped into reservoirs which supply the distribution system by gravity. The filtration plant has a capacity of 2.5 m.g.d. A new ground water supply capable of delivering about 8.5 m.g.d. is under construction. The Mountain States Power Company system furnishes water to 10,760 people living in Springfield. The average water use is about 2.73 m.g.d. and the maximum use 5.60 m.g.d.

Industrial Water Supply[2]

In addition to the large amounts of water used by industries supplied through municipal sources, there are known to exist in the basin 63 separate industrial water supplies. Maximum use of industrial water supplies usually occurs during the summer and early fall when canning operations are at their peak. The average use during this period is estimated at 189 m.g.d.

Surface waters supply the needs of 17 industrial plants. The total demand upon surface sources for industrial purposes is 174 m.g.d. About 50 percent of this water is used for cooling purposes and the remainder for processing. Cooling waters are usually untreated while processing waters receive varying degrees of treatment depending upon the industrial process. This treatment may include any or all of the following: screening, filtration, softening, or chlorination. The 6 pulp and paper mills use about 72 percent of the total surface water requirements. Five of these treat a portion of their water by sedimentation and/or filtration. The remaining plant, which produces newsprint, provides screening facilities alone.

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[1] See Appendix 9, Section 5.

[2] See Appendix 9, Table 22.

Ground waters are used by the food processing plants and most of the smaller industries. Forty-six industrial plants, utilizing ground water sources alone, have a total demand of 15 m.g.d.

Because of the unsatisfactory sanitary quality and occasional high turbidity of the waters in the Willamette River, many industries which require waters of high quality prefer to utilize ground water rather than to undertake costly treatment of water from the Willamette River. For these reasons, food processing plants prefer to use wells. Most other larger industries along the Willamette River above Portland utilize river water after treatment by sedimentation, filtration and chlorination. In Portland Harbor treatment of the river water sufficient for food processing plants would be neither advisable nor economical. Well water, where found in adequate quantities, may usually be rendered satisfactory for food processing requirements by chlorination alone.

Agriculture

Although the practice of irrigation is still in its infancy, the growing vision of great economic benefits points clearly to an expanding irrigation use of the water resources. The need for irrigation on the fertile valley lands stems from the meager summer rainfall of as little as 6 inches, which limits the advantage of the long growing season. Many high value specialty crops cannot now be grown solely because of limited available water. Increased yields of 50 to 100 percent of better quality crops clearly demonstrate the value of water in the existing scattered areas where irrigation is now used.

A very rapid growth in irrigated acreage has occurred since 1930. It is now estimated that about 130,000 acres of bottom lands are irrigated by pumping directly from Willamette River and tributaries and by pumping from private wells. Estimated annual water requirements for this acreage are 260,000 acre feet. A total of about 1,000,000 acre feet of water will be required to supply the more than 500,000 acres of irrigable land in the Basin.[1/] Competition for water requires that major irrigation

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[1/] See Appendix 9 -- Table 20.

developments include storage of flood flows for release during the growing season. Multiple-purpose reservoirs, constructed and being constructed by the Corps of Engineers, together with additional proposed reservoirs, will provide storage to meet potential requirements for irrigation water.

The relationship between irrigation and pollution is sufficient to warrant planned considerations. Pollution already has affected water used for irrigation in certain parts of the mainstem and some tributaries. How serious this aspect of the pollution problem will become is not known and requires investigation. It is expected that new pollution problems will arise as a result of expanded agricultural activity. There will be competition between use of water for irrigation and that required to stabilize the basin's growing stream of pollutional wastes. Soil and farm drainage will be swept into the streams in greater amounts. Problems in cannery waste disposal will follow the harvesting of increased yields of many kinds of crops.

Surface waters are used by poultry and livestock in many parts of the basin. In 1944 there were more than 4,000 dairy farms, 3,000 poultry farms and almost 2,000 livestock farms in the basin that placed on the market products worth about 43 million dollars.

Fishery

Migratory fish such as salmon and steelhead trout, together with resident rainbows and cutthroats, form the nucleus of an important fishery resource. The migratory fish, after a 1 to 5 year feeding sojourn in the Pacific Ocean, pass through the Willamette to the spawning grounds in the far reaches of the tributaries. The young produced here in turn repeat the round trip journey of their parents, ending again at the spawning areas. Twice in each lifetime the Willamette River becomes a connecting link between the ocean and the gravel beds where the eggs are laid. Until the young fish reach the ocean, their food supply must come from the array of small animal life produced in the watercourses. It is thus apparent that fulfillment of the hopes of many people for restoration of the fishery to its former abundance requires, among other things, clean water in all parts of the drainage system.

Angling for salmon and trout is extremely popular and has increased tremendously with the wartime and postwar population growth. Sport fishing only is permitted in the basin, but Willamette-bound salmon and steelheads are intercepted by fishermen's nets in the lower Columbia, and many basin-reared fish are taken by trolling on the ocean. The 1947 retail value of this commercial catch was about $885,000.[1] Much of the sport fishing, other than for salmon, is for rainbow and cutthroat trout of which about 4 million are released in the streams annually. Even the spiny-rayed fish of the sloughs and slower water, that are looked upon with disdain by the dyed-in-the-wool trout fisherman, are familiar and welcome to newcomers from beyond the Rockies. Their rising popularity will relieve to some degree the growing situation of too many fishermen for too little trout water. The attraction of these fish and the basin's fishing waters induced the 1948 anglers to part with more than 12 million dollars in financing their sport.[1/]

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[1] Estimate of Oregon Fish Commission.

In reference to the fishery, there is a two-fold importance in the water resources: they must provide fishing for the fisherman and must hold up with all their fish-raising potential the once fabulous but declining salmon fishery of the Columbia River. The far-flung spawning areas, once scattered over 90,000 square miles of drainage area, are becoming smaller and smaller. Future development of the Columbia's great water resources will place a greater salmon-raising burden upon the lower tributaries. The Willamette is an important one still partially accessible. Its great potential powers for raising fish are not being fully used and only now are being systematically explored.

Under present conditions in the Willamette, spring runs of salmon tend to grow smaller and smaller, fall runs are virtually gone, and returns are poor from the heavy angling for resident fish in spite of hatchery rearing and frequent plantings.

1/ Estimate of Oregon Game Commission.

Many factors are responsible for this dismal fishery picture: overfishing, poor land and water uses, logging, obstructions of many kinds, pollution and other competitive uses of the water resources. Full expansion of the fishery will be governed by the extent to which these factors are corrected. Pollution abatement alone is an important need in the mainstem and lower reaches of certain tributaries.

Rehabilitation of fall-migrating salmon awaits permanent improvement of water quality in the Lower Willamette where oxygen-demanding industrial and community wastes make the river seasonably impassable to fish. In many reaches the river and tributaries must be improved for the safe downstream passage of fingerlings. Occasional fish kills must be prevented by proper disposal of industrial wastes. Protection of fish from pollution is a popular movement; the future of the fishery will be governed largely by its success.

Recreation

The Willamette River, although once a recreational asset of great importance, now carries along in its lower reaches slicks of dirty oil and various kinds of debris. Pleasure boats avoid the dirty lower river with its many floating obstructions and use less convenient moorages on the Columbia River. The river is unfit for swimming or any other use that requires clean water. As a result of pollution, the waters close to the population centers have lost their recreational value and scenic appeal. They are avoided more and more as weekend vacationists follow highways, country roads and forest trails to waters unspoiled or less affected by pollution.

The remaining clean waters of the basin are a resource of great value. They are the motivating force behind sales of picnic and camping equipment, fishing tackle, boats and sporting goods of many kinds, clothing, and a maze of other items. The basin's residents purchased a large share of the State's 1948 issue of 270,000 anglers' licenses worth more than a million dollars. These waters bring visitors from other areas--2¼ millions for the State in 1949. They are a starting point for the State's 110 million dollar tourist business which is second only to lumber and agriculture.

Navigation

Many geographic features of the Portland area have contributed to its rapid development as a growing metropolitan center. Not the least of these is the Willamette River serving as a connecting thoroughfare through the Lower Columbia with the high seas and world ports. The Port of Portland has docks for general cargo, grain, lumber, and oil; as well as shipbuilding and repair facilities to serve the domestic and foreign ships that come for wheat, lumber, and flour, and unload their cargoes of oil and freight. Almost 1.5 million short tons per year of the Columbia Basin's production are shipped out through this port while 5.5 million tons of oil and other freight are imported for distribution throughout the area.

Barge traffic between Portland and Oregon City connects the riverside industrial plants with the downstream shipping facilities. By this means, pulp and paper are carried downstream in return for oil and other needs of industry. During the 5 years ending in 1946, more than 224,000 tons of cargo and 1.7 million tons of logs were moved through the Willamette Locks each year.

The major item of commerce on the Willamette above Portland is the seemingly endless fleet of log rafts passing along from the forests to the many wood-conversion plants scattered downstream.

Hydroelectric Power

Growing demands for power exceed the basin's hydroelectric generating resources with installed capacity of about 99,000 kilowatts.[1] These developments, which vary considerably in size, are well-scattered in the basin along the mainstem and tributaries. In addition to the hydroelectric power developed in the basin, there is approximately 158,000 kilowatts of steam plant capacity.

Power demands in the Willamette River Basin are far in excess of the present installed capacity. Industrial development in the Portland area and the continually increasing demands for power throughout the basin are dependent to a large extent on existing and future power developments on the Columbia River. Industrial expansion already has been discouraged by power shortages, and brown-outs during the 1949 peakload period emphasize the urgent need for more power.

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[1] See Appendix 9 -- Table 21.

The potential power resources of the Willamette River Basin total approximately one million kilowatts of prime power. Complete development of the basin's power resources would require an installed capacity of about 2 million kilowatts. Presently authorized Federal projects and additional projects recommended in the "Columbia River and Tributaries, Review Report" prepared by the Corps of Engineers in 1948, would provide for 387,000 kilowatts of installed capacity. The authorized and proposed projects can most effectively supplement Columbia River plants by supplying at least a part of the peak load requirements of the basin. Also, these plants would be available to supply baseload demands during periods of low flows on Columbia River.

Wildlife

Many species of upland game, birds, migratory waterfowl, and deer use the water resources of the Willamette Basin. The original ringneck pheasant, which was imported to the United States from China, was first planted in the Willamette River Basin in 1887. Native and blue grouse are other species of upland game birds found in the area. Large numbers of migratory ducks and geese use the basin as a flyway and a portion nest in the area. Black Tail deer inhabit the forested mountain areas.

POLLUTION CONTRIBUTED TO WATER RESOURCES

Pollutional damages to the Willamette's water resources are caused by a great variety of foreign substances traceable mainly to industry and municipalities. From Cottage Grove downstream, and on the tributaries, many cities and industries have sewer outfalls to drain their wastes to the river system.

Public spirited citizens are becoming aware of the kinds and effects of polluting wastes that are discharged to basin waters. Best known, perhaps, are domestic sewage and the many kinds of trade wastes. Silt, oil, grease, sawdust, bark, and slashings also belong in this group of agents that help to destroy the utility of the water.

The dumping of raw sewage, which has been a practice of long standing at Eugene, Corvallis, Albany, Salem, and Portland, subjects the downstream water user to potential danger of typhoid, the dysenteries, and other waterborne infections. Where the water user is a community that depends upon the river for its public water supply, it is obliged by considerations of health and common decency to subject the water to a costly treatment process.

The similar effect of sewage and many industrial wastes in removing oxygen from receiving waters makes it possible to compare relative strengths of these wastes and to evaluate them in a simple system of terminology. For example, the wastes from the processing of 200 pounds of sulphite pulp, or 90 cases of canned pears, would remove from the receiving waters about as much oxygen as the untreated sewage from 300 persons. As stated in the usual way, each of these quantities of wastes has a population equivalent of 300.[1] In following this same system of evaluation, some of the basin's larger sulphite pulp mills discharge wastes with a population equivalent in excess of 800,000.

Waterborne particles of matter, such as sewage solids, sawdust, bark, chips, wood fiber, fragments of fruits and vegetables and silt are additional components of the pollutional load. They settle in quiescent stretches and form malodorous sludge banks. Moreover, there may also be toxic substances from industrial wastes, compounds causing tastes and odors, coloring matter, grease, and oil. In various combinations and quantities, these many substances affect adversely the various qualities and uses of the water resources.

All too frequently in the past, development of sewerage systems as a necessary convenience of modern urban life was not coordinated with the simultaneous building of sewage treatment facilities. Watercourses were near at hand, and, as long as they carried the discharged sewage away from the community, no further obligation in sewage disposal was recognized. But, as the population grew, so also did the volume of sewage. The resulting pollution of the Willamette system already endangers public health and limits the utility of the water.

1/ Usually expressed as B.O.D., population equivalent; this is a daily-discharged quantity of waste with a 5-day, 20° C., B.O.D., requirement of 0.167 pounds.

Known sources of pollution in the Willamette Basin include the wastes from 52 sewered municipalities and 83 industrial establishments.[1] More complete surveys now underway should disclose additional sources of both municipal and industrial pollution as well as the sources of all other pollutional substances now entering the basin's watercourses. The organic pollutional load contributed from about 80 percent of the known sources is estimated to have a population equivalent of about 4,000,000, or nearly 5 times the basin's present population.[2]

Of the 52 sewered municipalities serving a total population of 488,450, 19 discharge the raw sewage of 441,050 people into the Willamette and its tributaries.[3] Draining to the main stem alone, are Springfield with 10,000 people, Eugene with 35,000, Corvallis with 15,000, Albany with 9,000, Salem with 40,000, Portland[4] with 294,000 and 6 others of smaller size. The drainage of the Yamhill, Santiam, Clackamas, Molalla, and other tributaries carries the raw sewage from 7 additional municipalities into the main stem. The remaining 33 municipalities serving a population of 47,400 treat their sewage prior to discharge.

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[1] See Maps 5 and 6 for locations.

[2] See Plate 1.

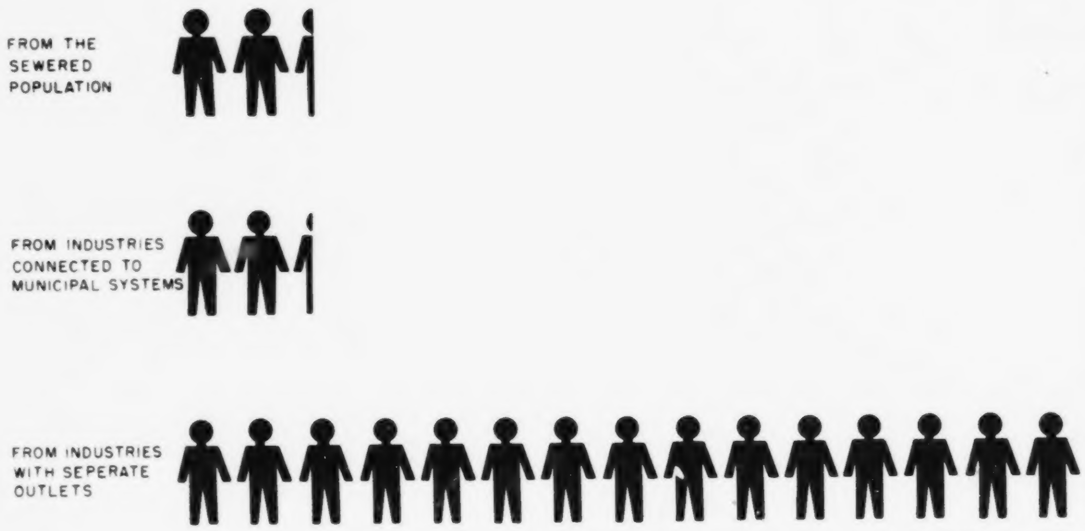
[3] See Appendix 9 -- Table 1.

[4] The part of Portland's population lying within the Willamette Basin.

52-A

WHERE POLLUTIONAL DISCHARGES ORIGINATE

WILLAMETTE RIVER BASIN



EACH SYMBOL REPRESENTS EQUIVALENT B.O.D. WASTES FROM 200000 PERSONS

PLATE NO. 1

Because industrial establishments are frequently connected to city sewerage systems, the average load, expressed as population equivalent is usually greater than the sewered population. For this reason, the population equivalent of the mixed wastes from all municipalities is more than 900,000 in spite of limited treatment, while the sewered population is only 488,450. Therefore, on the basis of oxygen demand in the receiving waters, the industrial wastes comprise at least 45 percent of the total pollutional load discharged to the Willamette River System by municipalities.

About 83 streamside industrial plants have their own facilities for disposing of process wastes.[1/] In some cases, they consist of no more than simple sewers discharging into the river. The majority of these 83 plants are ones that process agricultural products such as fruits, vegetables, meat and milk, or make pulp and paper from the area's timber. Information on waste character and quantity is partially known for 60 plants. Of these, 20 discharge wastes with a total population equivalent of 3,028,150; while present information indicates the remaining 40 probably are not discharging wastes of a pollutional character. When compared with the presently known discharges from all sources, which aggregate nearly 4 million population equivalent, these 20 plants have a grave responsibility for their contribution to the present condition of the Willamette River.

[1/] See Appendix 9 -- Table 2.

Private citizens and spokesmen for various civic groups have frequently criticized industry in the Willamette Valley for its alleged inactivity in preventing water pollution. Although a number of seasonally-operated fruit and vegetable canneries have received specific attention, the most serious criticisms have been leveled against the 5 sulphite pulp manufacturers at Salem, Lebanon, Newberg, Oregon City and West Linn. During 1949 the wastes from these industries had a population equivalent of 2,851,000[1]--about 6 times the sewered population and several times as great as the polluting wastes from all other sources in the basin.[2] The following table shows the relationship between the population equivalent of wastes from the sewered communities with their 150 connected industrial plants and the known industries not connected to municipal systems. This emphasizes the preponderance of pollutional effect of the 6 pulp mills.

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[1] Derived from actual data cooperatively submitted to Oregon State Sanitary Authority by plants of the pulp and paper industry.

[2] See Plate 1.

Sources of Polluting Substances		Population Equivalent
From 52 sewered communities with 150 connected industrial plants		920,040
From industrial plants not connected to community sewers:		
6 pulp mills	2,901,000)	
14 other industrial plants	127,150)	3,028,150
40 other industrial plants	0	
23 other industrial plants	Unknown	
TOTAL		3,948,190

A summary of the data on sources of pollution is contained in Tables A and B as follows:

TABLE A — SOURCES OF POLLUTION — MUNICIPAL

Municipalities*	Sources of Pollution (in Number of Municipalities)*	Population Served by Sewerage System	Amount of Pollution Discharged to Watercourse. Population Equivalent.**
Having Data on pollution load discharged to watercourse.	52	488,450	920,040
Having population data available (Data on pollution load to watercourse incomplete or not available)			
TOTAL	52	488,450	920,040

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

** Includes industrial wastes discharged into municipal sewerage systems.

TABLE B — SOURCES OF POLLUTION — INDUSTRIAL

Industries*	Sources of Pollution (In number of plants)	Amount of pollution discharged to watercourse (in terms of Population Equivalent)
Producing Organic Wastes	60	3,028,150
Producing Organic Wastes	17	Undetermined
Producing Inorganic Wastes	3	Undetermined
Producing Wastes of Undetermined Type	3	Undetermined
TOTAL	83	— — —

* Industries having separate outlets discharging wastes directly to watercourse.

Because little information is available for one-fourth of the industrial plants that handle their own wastes, evaluation of the overall situation of pollution is limited. A similar situation applies to industrial plants which are connected to municipal sewers. If such information could be obtained through surveys in sewered municipalities, and at outlying industrial plants, it would be a valuable guide to current and future efforts toward pollution control.

A less objectionable part of the basin's pollution load consists of silt from agricultural and other lands. Such soil losses to the drainage system result in increased turbidities during the rainy season. During February of 1949, hard rains on thawing soils caused erosional effects upon 97,000 acres of agricultural land.[1] Estimates of the Soil Conservation Service indicate that about 1,150,000 tons of soil were washed down the Willamette drainage system during this month. Most of this is believed to have been swept on into the Columbia River. The continued deposit of a small part of the silt in Portland Harbor is sufficient to require dredging of the navigational channels every 4 or 5 years.

The principal and best known polluting agents discharged to the basin's waterways are: (1) sewage or pathogenic bacteria; and (2) substances which react either chemically or biochemically with the aid of bacteria to affect adversely the oxygen resources of the streams. Other kinds of polluting substances, such as toxic wastes, silt from gravel washing, and sawdust and drainage from log ponds of sawmills, are also important, but little information is available as to the extent or effect. The latter also is true of increase of turbidity and clogging of salmon streams by slashings as an aftermath of logging operations on many tributary watersheds.

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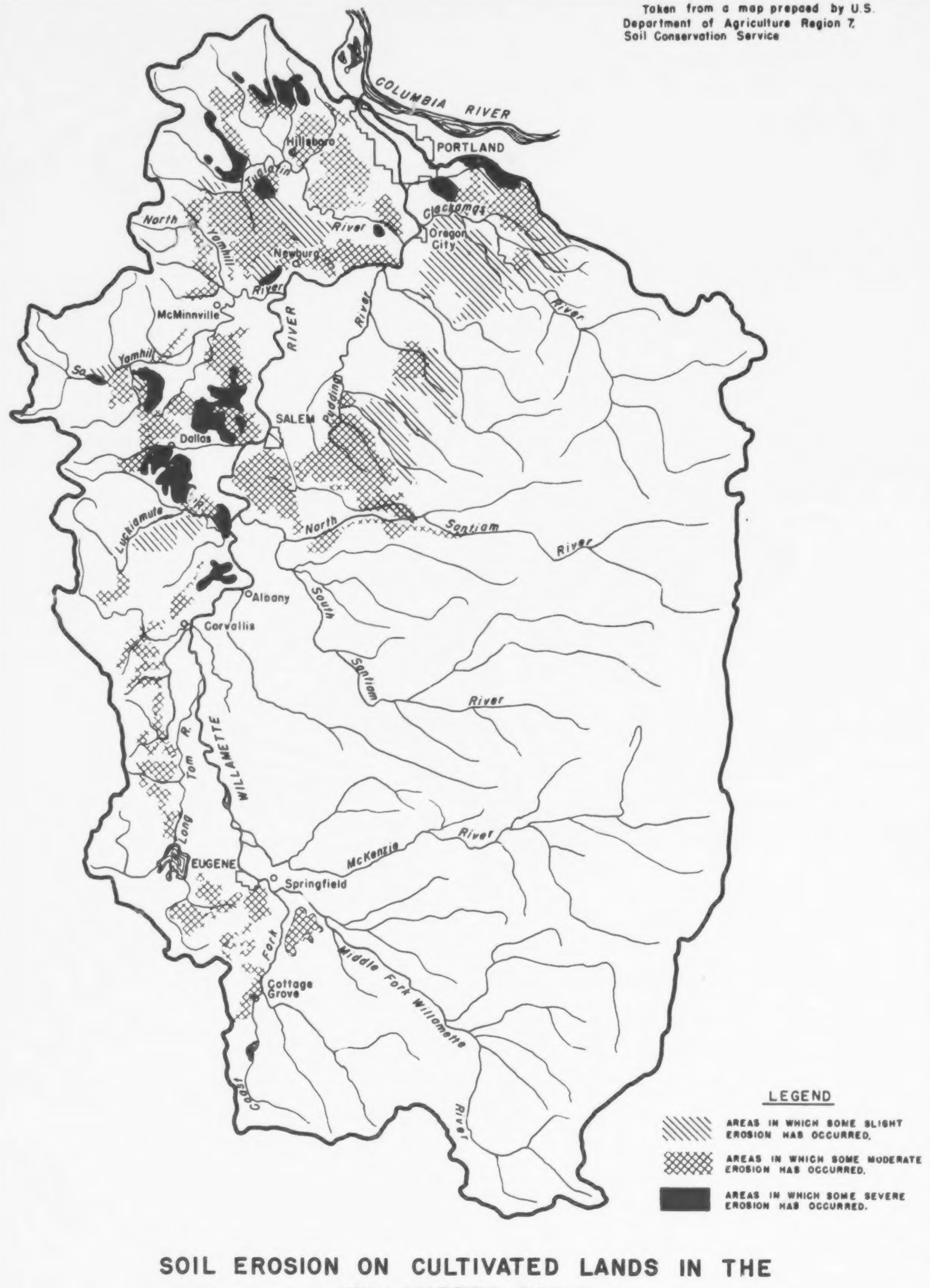
[1] See Plate 2.

Taken from a map prepaed by U.S.
Department of Agriculture Region 7,
Soil Conservation Service


COLUMBIA RIVER
PORTLAND
Hillsboro
Tualatin
River
North
Yamhill
Newburg
Clackamas
Oregon City
River
River
McMinnville
So. Yamhill
RIVER
River
Pudding
SALEM
Dallas
Luckiamute
North
Santiam
River
Albany
South
Santiam
River
Corvallis
Long
Tom
R.
WILLAMETTE
EUGENE
Springfield
McKenzie
River
Coast
Fork
Cottage Grove
Middle Fork Willamette
River
LEGEND
▨ AREAS IN WHICH SOME SLIGHT EROSION HAS OCCURRED.
▩ AREAS IN WHICH SOME MODERATE EROSION HAS OCCURRED.
■ AREAS IN WHICH SOME SEVERE EROSION HAS OCCURRED.

SOIL EROSION ON CULTIVATED LANDS IN THE
WILLAMETTE BASIN

FEBRUARY 1949

PLATE NO. 2

DAMAGES TO WATER RESOURCES FROM POLLUTION

Surveys and investigations have not been needed to show the Willamette Valley people that their waterways have been damaged by pollution. They already are aware of the many changes that have come about gradually during this first half of the 20th Century. Damaging pollution became an accomplished fact as the growing cities built their sewers, industrial plants grew larger and more numerous, and unwise water uses became more common.

At the turn of the Century the Portland waterfront and many areas upstream were popular places for recreation. At that time there were attractive picnic places, boat landings, flourishing bathhouses, and beaches where the water now is persistently dirty or visibly mixed with sewage. Such visual changes in the river system and the decreased use of the river are familiar damages near many of the Valley cities.

Intensity of pollution effects vary considerably with the season. During much of the year, dilution by large quantities of cold water from basin runoff prevents the serious conditions that occur during late summer and early fall when flows are low, temperature high, and pollutional discharges at a seasonal peak. Damages to the water resources during this period are excessive. They are damages that interfere with most of the present and potential water uses, lead to nuisance, other kinds of complaints, and are a serious health hazard.

Occasional surveys[1/] have been valuable in establishing the extent of pollution damages, identifying the offenders, and suggesting a logical course of corrective action. Widespread pollution has altered the physical, chemical and biological properties of the waterways so that there are now potential hazards to health of people, interference with normal water uses, and continuing destruction of resources that require clean water.

Public Health

Epidemics of waterborne diseases, such as typhoid and the dysenteries, frequently are cited as classical examples of the damages and dangers of sewage-polluted water. The Oregon State Board of Health came into being in 1903 after an outbreak of typhoid fever in cities using the Willamette for water supply--particularly Salem, Oregon City and Portland.

[1/] Reference following reports published by Engineering Experiment Station, Oregon State Agricultural College, Corvallis, Oregon:

"Preliminary Report on the Control of Stream Pollution in Oregon." Langton, C. V. and H. S. Rogers. Bulletin Series, No. 1, 1929.
"A Sanitary Survey of the Willamette Valley." Rogers, H. S. and C. A. Mockmore and C. D. Adams. Bulletin Series, No. 2, 1930.
"A Sanitary Survey of the Willamette River from Sellwood Bridge to the Columbia River." Gleeson, G.W., Bulletin Series, No. 6, 1936.
"Industrial and Domestic Wastes of the Willamette Valley." Gleeson, G.W. and F. Merryfield. Bulletin Series, No. 7, 1936.
"1945 Progress Report on Pollution of Oregon Streams." Merryfield, Fred and W. G. Wilmot. Bulletin Series, No. 19, 1945.
"The Fishes of the Willamette River System in Relation to Pollution." Dimick, R.E. and Fred Merryfield. Bulletin Series, No. 20, 1945.
"Industrial and City Wastes." Merryfield, Fred and W. B. Bollen and F. G. Kachelhoffer. Bulletin Series, No. 22, 1947.

Reproduced from best available copy.

Most communities have gone to unpolluted tributaries for their water supplies, and there is much less intensive use of the Willamette for bathing. Isolated effects upon individuals are more difficult to trace and, therefore, the total damage to the health of persons is not well known.

Health officials of the State of Oregon have pointed out repeatedly that the sewage-polluted waters of the Valley are a constant threat to public health. Their stand is based upon simple facts that are apparent to anyone. Large quantities of raw sewage enter surface waters from most of the valley communities. Surveys have shown excessive contamination of surface waters by sewage bacteria. It is possible that bacteria from diseased persons may be present and affect people who, in their work or recreation, have intimate contact with these waters.

The simple logic of this anti-pollution stand was well borne out by a serious outbreak of gastro-enteritis among workers at a Portland shipyard in October of 1943. During a period of two weeks following October 22, there were 1179 visits at the yard dispensary for treatment of abdominal cramps, vomiting and diarrhea. Absentee rates varied from 10 to 15 percent, and it was estimated that at least 2,000 employees were affected. Investigation showed that the water supply of the shipyard had somehow become contaminated and that the usual sanitary barriers against contamination had broken down. In tracing out all of the possible sources of contamination, the dirty water of the Willamette River emerged as the most likely suspect. Not only did the river receive the raw sewage from 17 communities up the river, but along the bank 500 feet upstream a 60-inch sewer discharged sewage from the City of Portland. By following this lead it was found that a cross connection in the hull of a partially finished ship caused river water to be pumped into the water system. Connection between the sewage-polluted Willamette and the outbreak of waterborne disease was clearly shown.

This shipyard story completely supports the view that health hazards of the Willamette remain potential ones only so long as vigilant and effective barriers against contamination remain in operation. Once those barriers are lowered through carelessness or ignorance, the dangers of the Willamette become very real.

When the health of many people is affected at one time, the public is aroused and steps are taken immediately to determine the cause of the outbreak. How frequently isolated individuals are similarly affected by intimate contact with sewage-polluted waters and go their way uncounted cannot be determined. It must be remembered that many people are bound to these surface waters in making a living. There are boatmen engaged in river traffic, shingle and sawmill employees who handle water-soaked logs, and farmers who pump these waters to irrigate their fields. Small children give no thought to pollution as they splash and play in the water or fish from the banks. There are many others who will persist in using these waters in many ways regardless of their condition.

In the Willamette Basin the health aspects of pollution are important. Below cities that lack sewage treatment facilities surface water is a constant threat to health, and no one can predict when circumstances will permit the outbreak of an epidemic. The effect upon the health of people already chargeable to water pollution may be great. Examples of damage are known, but the extent of this damage is difficult to determine. Money values can be attached to sick days lost from work or to the fees for medical care, but no one can put a price tag on health itself or the threat to health.

Public Water Supply

Because sewage pollution makes parts of the Willamette and tributaries potentially dangerous to public health, it would be unthinkable to use these waters for public supply if other sources could be developed. At many points where it would be convenient and economical to draw upon river water, the bacterial content[1] was found to be greater than can be treated with confidence by the most modern methods. This is the situation below Eugene, Salem, Newberg, and Oregon City. During the

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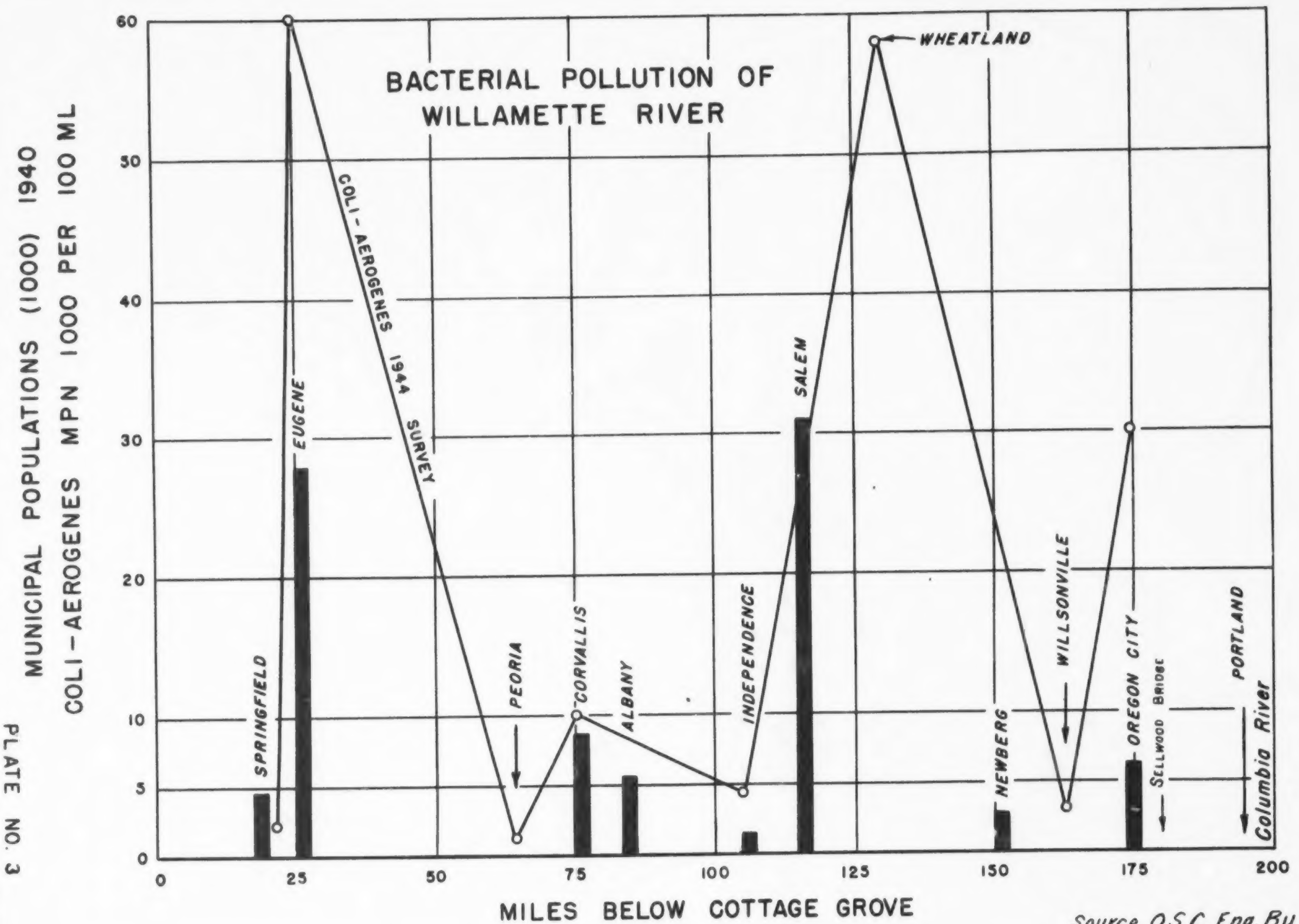
1/ See Plate 3.

summer and fall, at least, the water below Cottage Grove, Corvallis, and Albany is not safe to use unless subjected to filtration and chlorination. Conditions are similar on parts of Rickreall Creek, South Yamhill, South Santiam, Pudding, and Tualatin Rivers.

Stream surveys made in 1929 and 1944 show that bacterial pollution has become more pronounced. Many parts of the waterway system that were suitable for public water supply with disinfection alone have become so changed by increased sewage and industrial waste pollution, that even the thoughts of using such water are disagreeable.

The City of Salem obtained water from the Willamette River until 1937, at which time the system no longer could meet the growing demands for service. When it became apparent that a new supply system must be developed, the City was faced with two alternatives. A modern complete water treatment plant could be constructed to convert Willamette River water to a potable product, or water from the North Santiam could be given fairly simple treatment, piped to the City, and turned into the distribution system. Salem selected the North Santiam even though the construction cost was one-half million dollars more than using the Willamette.

Before the turn of the Century, when Portland was emerging as a growing city of importance near the mouth of the



BACTERIAL POLLUTION OF WILLAMETTE RIVER

Source O.S.C. Eng. Bu. 2 & 19

PLATE NO. 3

Willamette, river water was acceptable for public water supply. Again the threat of increased pollution caused the city to look elsewhere for clean water--in this case 30 miles away on the northwest slopes of Mount Hood.

The problem of getting enough clean water is shared by all cities of the Willamette Valley. Some cities are more fortunately located than others, and have some degree of choice in selecting a source of supply. That is no longer true of Corvallis, although many years ago that city selected the Mary's River watershed for its supply in preference to the Willamette. After having developed and tapped every other feasible source of water, and not meeting adequately the needs of the rapidly growing population, Corvallis now has turned to the Willamette River. A treatment plant, that converts the polluted water of the Willamette River to an acceptable product, has cost the 16,000 people of Corvallis, $443,500. They have come under the damaging impact of Willamette pollution because no other source of water is available. A good part of the construction and operational cost of the plant is a chargeable damage of pollution.

In its present condition of pollution, the Willamette cannot be relied upon as a sole source of domestic water supply. In the event of treatment plant breakdown, emergency chlorination alone is not sufficient to make the water dependably safe for human consumption. The Willamette poses other water supply problems also. Objectional tastes and odors, turbidity, and moderately high temperatures make production of a water acceptable to the consumer difficult and expensive.

The usual pollution from communities and industries is not the only cause of water supply problems. As pointed out elsewhere, logging and gravel washing have caused considerable damage on some watersheds. Although Cottage Grove, Lebanon, Silverton, Forest Grove, Hillsboro, Sweet Home, Albany, Oregon City, West Linn, Carlton, Yamhill, and Molalla have been exposed to such damages, the City of Dallas may be taken as a typical example.

This small community of some 4,700 people, lying 15 miles to the west of Oregon's capital city, depends upon the area drained by Rickreall, Applegate, and Canyon Creeks for its supply of water. Because the city has no control over these areas, liquidation logging by private corporations goes on unimpeded. Logging is finished on the watershed of Applegate Creek and its utility as a source of water is largely gone. Half the Canyon Creek watershed has been cut, and operations will continue until no usable trees are left standing. Cutting of timber is also going on along parts of Rickreall Creek. Damages to the water supply already have appeared in the form of decreased yield, increased turbidity, and development of taste and odor-producing organisms. These conditions have necessitated pumping additional water from another source at an annual cost of $4,000, use of the existing reservoirs as settling basins, and construction of a new 3 million gallon reservoir at a cost of $125,000. In spite of these expenditures, the water quality is poor. Filtration may be needed in the near future.

In 1948 the domestic water supply of Sweet Home was troubled by pollution with sawdust from a sawmill located above the water intake on the South Santiam River. Through prompt action by the State Sanitary Authority, this pollution was immediately abated before extensive damage to the water supply was incurred.

Fishery

Damages to the Willamette fishery resources have been ones that destroy fish directly or affect adversely the ability of the water system to propagate fish and aquatic life.

Outright destruction of fish by pollution has been observed on the main stem or tributaries during almost every year since 1940. Late summer and early fall is the danger period for this impact upon the fishery, because at this season water temperature is high, stream flows are low, and wastes from seasonal processing are added to all the other usual wastes. The combination of these factors leads to periodic fish kills from poisoning or suffocation. The most recent fish kill occurred on the Tualatin River in September of 1949. Waste discharges from two fruit and vegetable canneries at Forest Grove had so overloaded the obsolete municipal sewage treatment plant that the river could not absorb the pollutional load without damage. At Hillsboro, also, cannery wastes entered the river. The dead fish, including rainbow and cutthroat trout, were pictured and described in the press, and the public was kept informed of each new development. Angry protests of such preventable fish destruction came from many fishermen and conservation-minded people.

Although many persons are made aware of pollution damages by the occurrence of isolated fish kills and consequently demand immediate correction, gradual and continuing changes over large parts of the waterway system are more detrimental to the total fishery resources. Continuously, or frequently, unfavorable oxygen conditions have developed below a number of points where excessive pollutional discharges occur. Linear zones of this type extend along the Willamette, Pudding, Yamhill, South Santiam, and Santiam Rivers; and Rickreall, Cedar and other creeks. These areas are unfit and often dangerous to local fish, and bar the movement of other fish to their spawning or feeding grounds. At most of these places, as well as on the Long Tom and Calapooya Rivers, pollution has destroyed or disrupted the supply of minute fish food organisms.[1]

Along with these damaging changes, many other unwise water and land uses akin to pollution gradually change the fish habitat. Log jams and slashings have made valuable streams unusable for fish. Sawdust and drainage from log ponds are causing trouble in some places. Silt from logging operations, gravel washing, and erosion have spoiled certain streams for both spawning and fishing.

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[1] Reference: "The Fishes of the Willamette River System in Relation to Pollution." Dimick, R. E. and Fred Merryfield. Bulletin Series No. 20, 1945. Engineering Experiment Station, Oregon State College, Corvallis, Oregon.

Tremendous quantities of pollutional wastes come down the Willamette from all parts of the basin, and move through the lower river and Portland Harbor on their way to the Columbia. At no time during the year are conditions in the harbor favorable for fish, but during periods of low flow, this situation is the most serious obstacle to full development of the basin's potential fishery. As shown in Plates 5 and 6, the oxygen content that starts dropping seriously at Salem is sometimes entirely eliminated in Portland Harbor during late summer and early fall. For this reason, fall-migrating salmon, that were once of considerable importance, have practically disappeared. If a sizeable run still existed, it could not pass through the pollution barrier that stands between the fish and their spawning tributaries.1/ Although spring-migrating salmon are still exposed to other effects of pollution in this region, oxygen conditions during high spring flows permit upstream migration.

Voluntary efforts to abate pollution in order to improve the fishery have been extremely limited. Oxygen conditions are

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1/ See Plate 4.

growing progressively worse so that, since 1934, the pollutional barrier has increased at least 30 miles in upstream length.

Reestablishment of the fall salmon runs is urgently needed in the Willamette River to support the maintenance of a Columbia River salmon fishery. State and Federal action now is coordinated in removing physical migration barriers, improving spawning areas, and accelerating the hatchery program. Removal of pollution damages is needed at many places at the same time. Projected fishery plans for rehabilitation of a fall run of salmon cannot be put into effect until the pollutional barrier in the lower river is dependably corrected.

During 1941 and 1942, sport fishermen took an annual average of 20,000 spring chinook salmon valued conservatively at $300,000.[1] This represents an income of 4 percent on a natural resource worth 7.5 million dollars. The 1947 commercial catch of Willamette spring salmon had a retail value of $885,000[2]-- a 4 percent return from 22 millions. That means that the total spring chinook fishery of the Willamette system is worth in the neighborhood of 25 to 30 million dollars. If the potential value of a fall run that could be developed is only one-fourth as great, the watercourse damages from pollution, by preventing this development, are costing the basin people the income from a 5 to 7 million dollar resource.

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[1] *Fish and Wildlife Scientific Report* No. 33, 1946.

[2] Estimate of Oregon Fish Commission.

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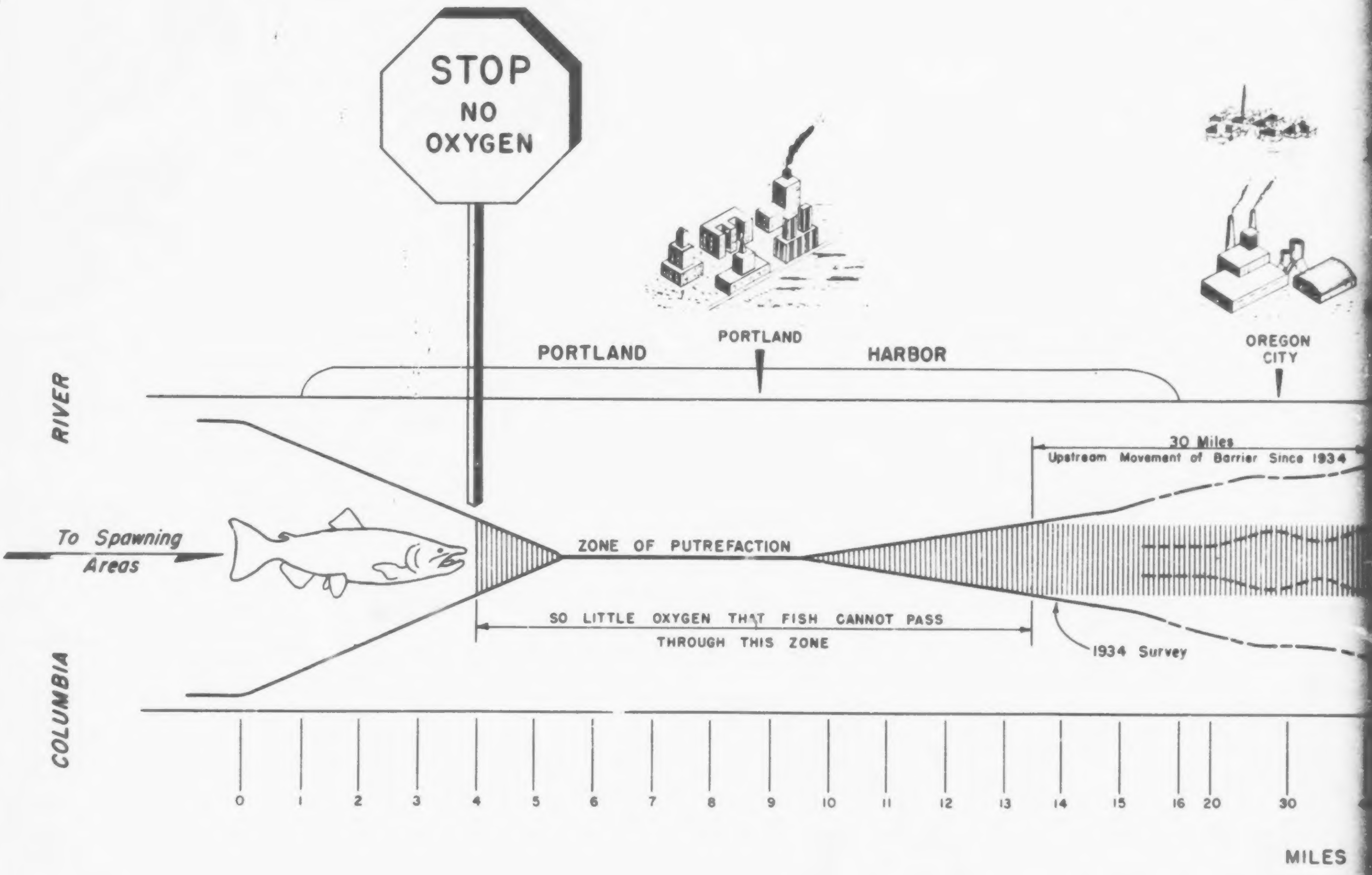
WILLAMETTE RI

CAUSED BY MUNICIPA
DURING LO


STOP
NO
OXYGEN
PORTLAND
PORTLAND
HARBOR
OREGON
CITY
RIVER
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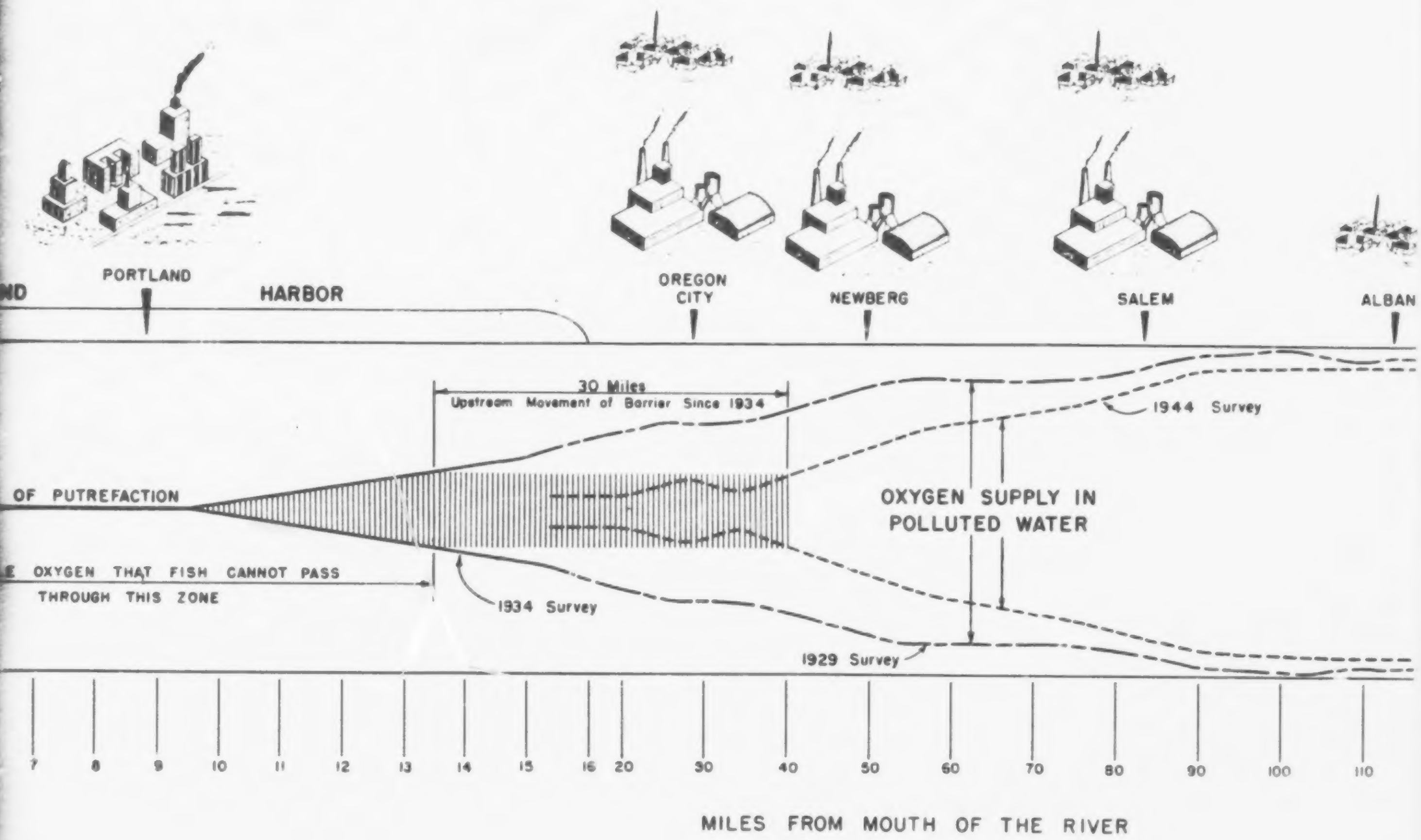
To Spawning
Areas
ZONE OF PUTREFACTION
SO LITTLE OXYGEN THAT FISH CANNOT PASS
THROUGH THIS ZONE
30 Miles
Upstream Movement of Barrier Since 1934
1934 Survey
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
20
30
MILES

SOURCE: DATA from O.S.C. Engr. Bu. 2, 6 & 19
IDEA from similar chart prepared by firm of
Stevens & Koon, Consulting Engrs. Portland, Oregon

WILLAMETTE RIVER OXYGEN BLOCK

CAUSED BY MUNICIPAL AND INDUSTRIAL WASTES
DURING LOW FLOW PERIODS


ND
PORTLAND
HARBOR
OREGON CITY
NEWBERG
SALEM
ALBAN
30 Miles
Upstream Movement of Barrier Since 1934
1944 Survey
OF PUTREFACTION
OXYGEN SUPPLY IN POLLUTED WATER
E OXYGEN THAT FISH CANNOT PASS
THROUGH THIS ZONE
1934 Survey
1929 Survey
7
8
9
10
11
12
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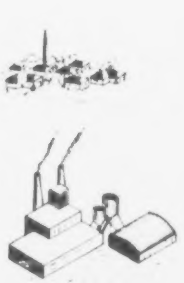
14
15
16
20
30
40
50
60
70
80
90
100
110
MILES FROM MOUTH OF THE RIVER



70-A B C

XYGEN BLOCK

USTRIAL WASTES
RIODS

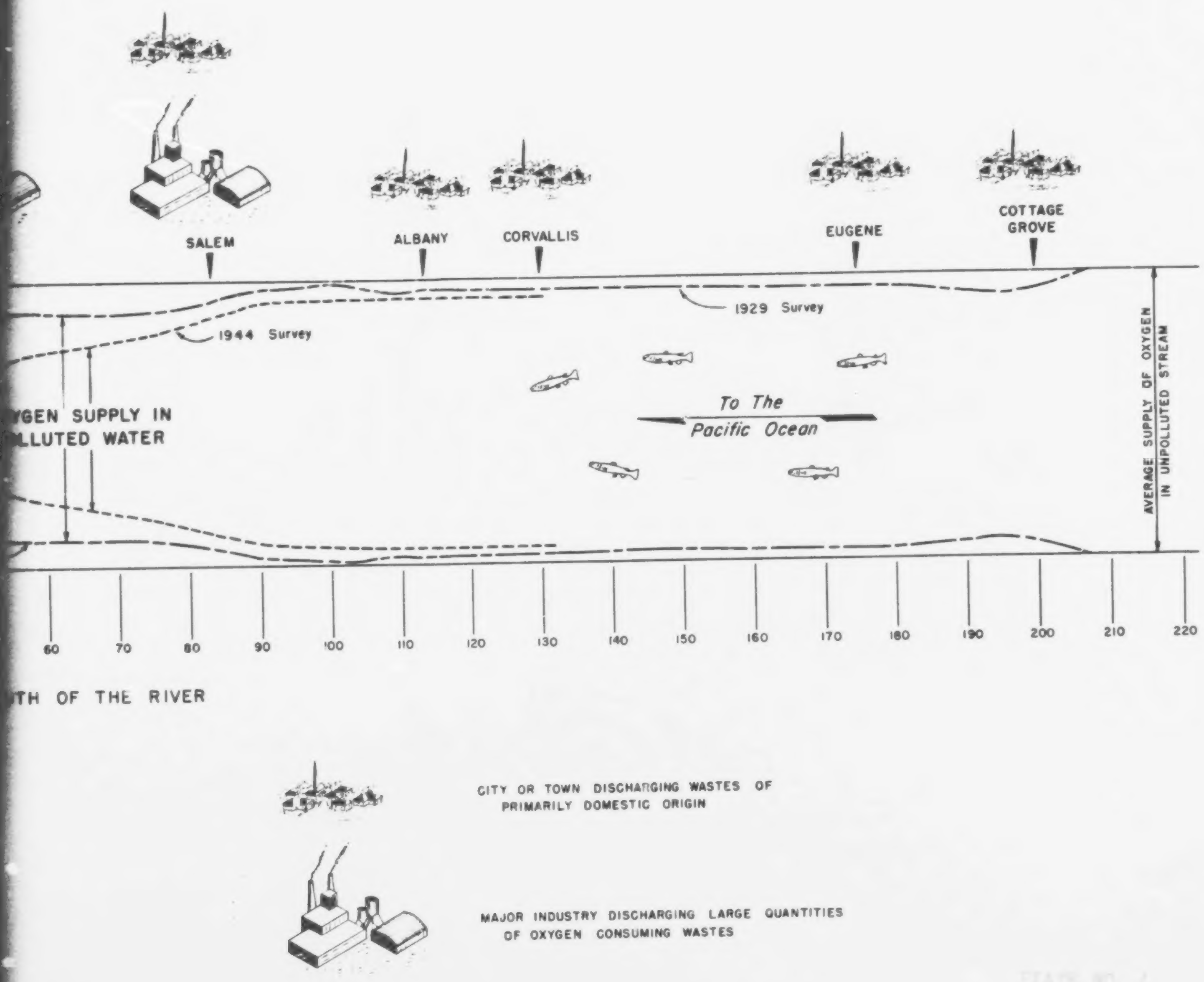

SALEM
ALBANY
CORVALLIS
EUGENE
COTTAGE GROVE
1929 Survey
1944 Survey
YGEN SUPPLY IN
LLUTED WATER
To The Pacific Ocean
AVERAGE SUPPLY OF OXYGEN IN UNPOLLUTED STREAM
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
TH OF THE RIVER
CITY OR TOWN DISCHARGING WASTES OF PRIMARILY DOMESTIC ORIGIN
MAJOR INDUSTRY DISCHARGING LARGE QUANTITIES OF OXYGEN CONSUMING WASTES

PLATE NO. 4

FEDERAL SECURITY AGENCY
U.S. PUBLIC HEALTH SERVICE
DIVISION OF WATER POLLUTION CONTROL

Navigation

Deposits of silt and sand originating from erosion of the basin's lands cause continuing damage in Portland Harbor, and make dredging necessary at 4 to 5 year intervals. Dredging was done most recently during 1949 at a cost of about $400,000.

Recreation

Destruction of bathing areas by pollution has continually confronted the basin people with three alternatives. They can ignore the warnings of public health officials and continue to use the rivers; or, for a safer course of action, they can stop swimming; or finance and construct artificial community pools.

In common with the history of the Portland area and Willamette River upstream, parts of Fern Ridge Reservoir, the old swimming hole near Lebanon, bathing places on the McKenzie and Willamette near Eugene, and many other isolated places have passed out of the recreational bathing picture. As a countermeasure, a $100,000 pool was built by the City of Eugene. Corvallis, Albany, Forest Grove, Salem, and 10 other communities also have constructed pools in substitute for the favorite waters lost to pollution.

The past expenditure of hundreds of thousands of dollars for 24 publicly-owned pools made necessary, in part at least, by the damages and health hazards of pollution, have not begun to meet the recreational needs of the people. The modern pool at Eugene is so popular and crowded that many people must be turned away. The City of Springfield is drawing up a financial program to permit the construction of a pool. Additional pools are sorely needed in other cities.

Although the health danger from continued use of outdoor beaches stems from heavy sewage pollution, industrial wastes have caused considerable damage in some places. Claims that some industrial wastes do not injure people do not make polluted water more attractive for swimming. The loss of natural bathing places, made useless by pollution, can never be fully compensated for by artificial pools. The added charm of swimming in natural waters will still attract many people, and children will go on swimming in natural waters if pool facilities are limited.

Damages to pleasure boating on the Willamette are those that injure or interfere with operation of the craft or prevent enjoyment by the occupants. Dirty oil and danger from collision with floating logs, blocks and bark, that seem to drift in endless procession on the lower river, discourage use of the Willamette. Most boats in the Portland area have been moved to the Columbia River. There is little inducement for cruising past the mouths of successive sewers on water that looks and smells like sewage. As far back as 1939 the City of Salem was the target of bitter complaints from the local yacht club of the stench "that reaches to high heaven" near the Willamette sewers. Like other recreational uses of water, boating, too, is being driven from the Willamette.

Near sizeable cities, such as Portland, Oregon City, Salem, and Eugene, the loss of picnic areas along the rivers due to pollution has been serious. At Independence a recreational park had to be closed because of sewage coming down from Monmouth through Ash Creek. Many of these areas still have potential value, and could be reclaimed and developed as part of a successful cleanup program.

Property

The pollution of the Willamette River has depreciated values of waterfront property at Salem, Oregon City, and Portland. Many excellent sites for homes, boat moorages, and other types of buildings remain undeveloped because of floating solids, scums, and odor nuisances. Downstream from Lebanon, similar river conditions and odors have decreased the value of property.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

Although benefits from pollution abatement of far-reaching importance are not as yet an accomplished fact, people eagerly await increased future benefits that will result from the coordinated programs now getting underway. The programs are motivated by a public desire for extended and more attractive uses of the water resources, and municipal programs and coordinated industrial action will do much to make this possible.

Of all the programs now underway by State and Federal agencies which are leading toward improved water quality in the Willamette River and its tributaries, the pollution control program of the Oregon State Sanitary Authority is probably the most important. The forestry programs of State and Federal agencies on public lands are placing special emphasis on the protection of public water supply watersheds, and are working toward reducing to a minimum silt, logs, bark, and other debris that now are, or in the future might be, washed into streams. The cooperative District and Federal soil conservation program works toward the reduction of soil losses from both privately and publicly-owned lands. Fishery agencies, both State and Federal, are removing obstacles from streams and improving bottom conditions for upstream migration and spawning. The Willamette River flood control program of the Corps of Engineers will improve water quality through reduction of peak flows during floods and regulated releases from water storage.

All of these efforts will be of tremendous value in improving conditions in the Willamette River and tributaries; however, full use of the basin's water resources for domestic and industrial supply, recreation and propagation of fish will not be realized until the sewage and waste treatment program of the Oregon State Sanitary Authority becomes effective.

Storage of flood waters in reservoirs which will be released, primarily for irrigation, navigation and power production, will also have some effect upon pollution. Although present plans of the Corps of Engineers and Bureau of Reclamation are based on the maintenance of a minimum flow of at least 6000 cubic feet per second at Salem during normal water years, there will be a number of months during low water years when this flow can not be maintained. Based on a study of past flow records for a 23-year period, it is indicated that even with all proposed reservoirs in operation monthly flows of as little as 4500 cubic feet per second at Salem will occur during extreme low water years. This same study indicates that, during about 25 percent of the July-October months, the flow will be less than 6000 cubic feet per second.

In order to determine the value of increased flows due to river regulation, oxygen sag curves have been plotted for flows of 2500 and 4500 second feet at Salem. Plate 5 includes calculated oxygen sag curves for the Willamette River below

Salem with a flow of 2500 second feet at Salem and the following pollutional loads: Curve A, present municipal and industrial wastes; Curve B, effluents from present treatment plants plus effluents from primary treatment plants for all other municipalities and industries; Curve C, effluents from present treatment plants plus effluents from municipal primary treatment plants and industrial intermediate treatment plants; and Curve D, effluents from secondary treatment plants at all municipal and industrial locations. The sewage and industrial wastes contributed at Portland have been excluded from these calculations because they will be treated and discharged into the Columbia River upon completion of Portland's sewage works program. Plate 6 includes oxygen sag curves for the Willamette river below Salem with a flow of 4500 second feet at Salem, and identical pollutional loads as used in Plate 5, with the exception that Curve A represents the actual measured dissolved oxygen content of the river on August 23, 24 and 25, 1950, at which time Portland's sewage and industrial wastes were being discharged to Willamette River. The river flow at Salem was 4500 cubic feet per second on August 23 when the survey was started.

Flows of 2500 and 4500 cubic feet per second represent minimum monthly flows that might be expected, first without and second with river regulation. Therefore, a visual inspection of the curves for similar pollutional load conditions indicates the value of river regulation. In order to maintain a minimum of 5

WILLAMETTE RIVER BASIN

DISSOLVED OXYGEN IN WILLAMETTE RIVER
WITH FLOW OF 2500 cfs AT SALEM

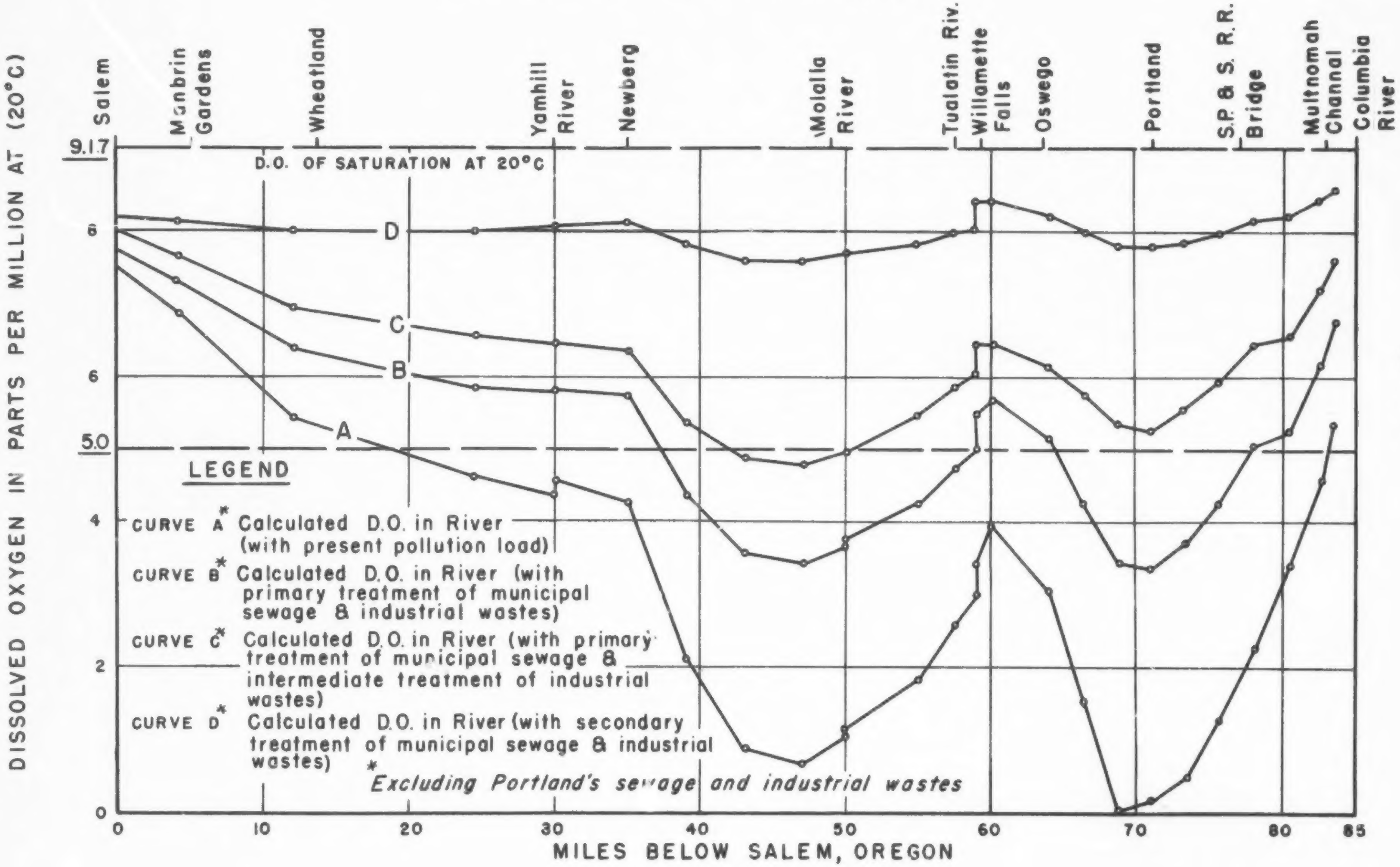


PLATE NO. 5

WILLAMETTE RIVER BASIN

DISSOLVED OXYGEN IN WILLAMETTE RIVER
WITH REGULATED MINIMUM FLOW OF 4500 cfs AT SALEM

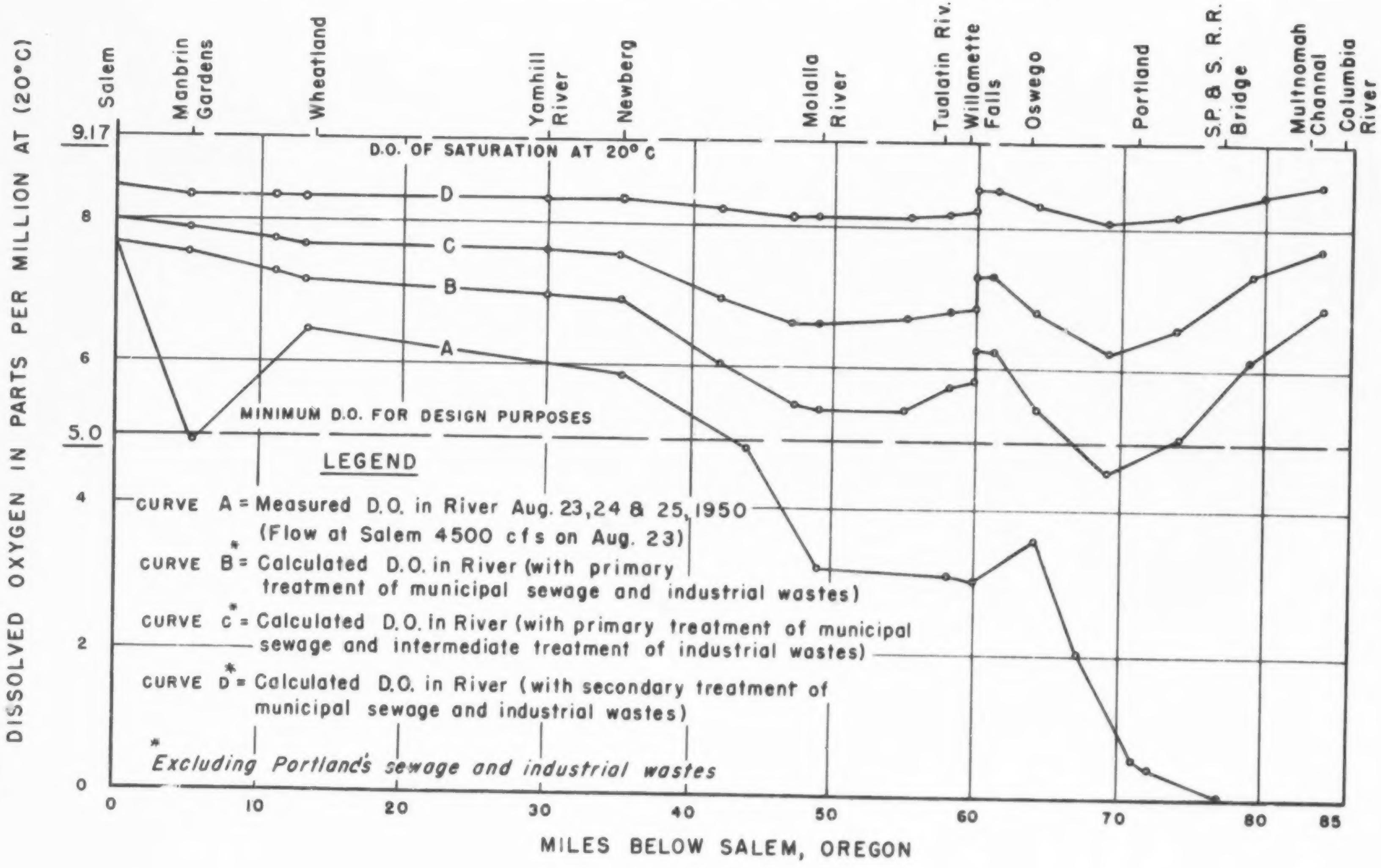


PLATE NO. 6

parts per million of dissolved oxygen in the river, intermediate treatment of all municipal and industrial wastes would be a minimum requirement with flows of 2500 cubic feet per second to be expected. With regulated flows, primary treatment of municipal sewage and intermediate treatment of industrial wastes would be the minimum requirement. Regulated flows also will permit a considerable population growth and industrial expansion prior to the need of a higher degree of treatment.

In addition to satisfactory oxygen conditions, pollution abatement will bring about many other improvements in water quality, most important of which is the bacterial quality. The elimination of raw sewage will permit the use of the river for development of public water supplies, industrial supplies, and recreational purposes without endangering the health of the people. The elimination of sludge banks, unsightly scums, oils, grease and obnoxious materials will be other expected improvements, and will undoubtedly increase the property values of real estate adjacent to the stream.

POLLUTION ABATEMENT MEASURES IN EFFECT

The control of water pollution in the Willamette River Basin has had public support for a number of years. An excellent example of this public feeling is the passage in 1938, by an overwhelming majority, of an initiative measure creating the State Sanitary Authority and investing it with powers to control water pollution. Unfortunately, World War II started about the time this agency was ready to function, and it was necessary, because of material, equipment, and labor shortages, to delay an action program of treatment plant construction.

Many of the abatement measures in effect in the Willamette Valley are a direct result of the educational and persuasive efforts of the Sanitary Authority. During the war period, cities were urged to prepare engineering plans and financing programs. Where this advice was followed, compliance with State pollution control laws has moved toward accomplishment with a minimum of civic hardship.

Financing of municipal sewage treatment facilities is fostered by appropriate State legislation passed in recent years. By a simple majority, residents of appropriate areas may establish sanitary districts with power to provide sewerage systems. These may be financed by general obligation bonds up to 25 percent of property value, and in addition by revenue bonds up to 15 percent. Municipalities have no statutory limit on indebtedness for general, limited obligation, or revenue bonds used to finance works that abate pollution.

Some of the smaller communities in need of sewerage systems have not been able to sell their bonds in the past, and accordingly were unable to provide sewage treatment. Since the spring of 1949, the Oregon State Bond Commission has been authorized by statute to purchase the bonds of municipalities with populations of not more than 2,500 should they fail to sell on the public market.

The activities of all these cities are effective measures toward abatement of pollution. If civic plans for sewage treatment facilities now complete, or in the drafting stage, were to be placed in operation within the next 5 years, sewage pollution of the Willamette system from municipal sources would be greatly reduced.[1]

Existing municipal treatment facilities consist of 32 treatment plants serving 33 communities. They vary in complexity from primary sedimentation plants to those with trickling filters or activated sludge equipment.[2] A summary of the existing plants is included in Table C.

1/ See Plate 7.

2/ Appendix 9 -- Table 1, and Map 5.

TABLE C -- EXISTING TREATMENT FACILITIES -- MUNICIPAL

Degree of Treatment Provided	Number of Municipalities* Served	Number of Treatment Plants	Population Served
Primary**	19	18	25,150
Secondary	14	14	22,250
No Treatment	19	0	441,050
TOTAL	52	32	488,450

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

** Includes 10 minor treatment plants, such as septic tanks.

Specific information on pollution prevention efforts by industry is known for most of the industrial plants. Although some others undoubtedly have incorporated waste prevention methods in their processing procedures, full-scale waste treatment plants have not been built.

A total of 233 industries located in the basin have liquid wastes which they dispose of in some manner. One hundred fifty discharge through city sewers and 83 discharge through industrially owned facilities. Treatment of some kind is provided for wastes from about 33 percent of the industrial plants. Twenty-three percent of the industrial plants use industry-owned treatment facilities, whereas 10 percent use municipal treatment

SEWAGE TREATMENT FACILITIES FOR URBAN POPULATIONS

WILLAMETTE RIVER BASIN

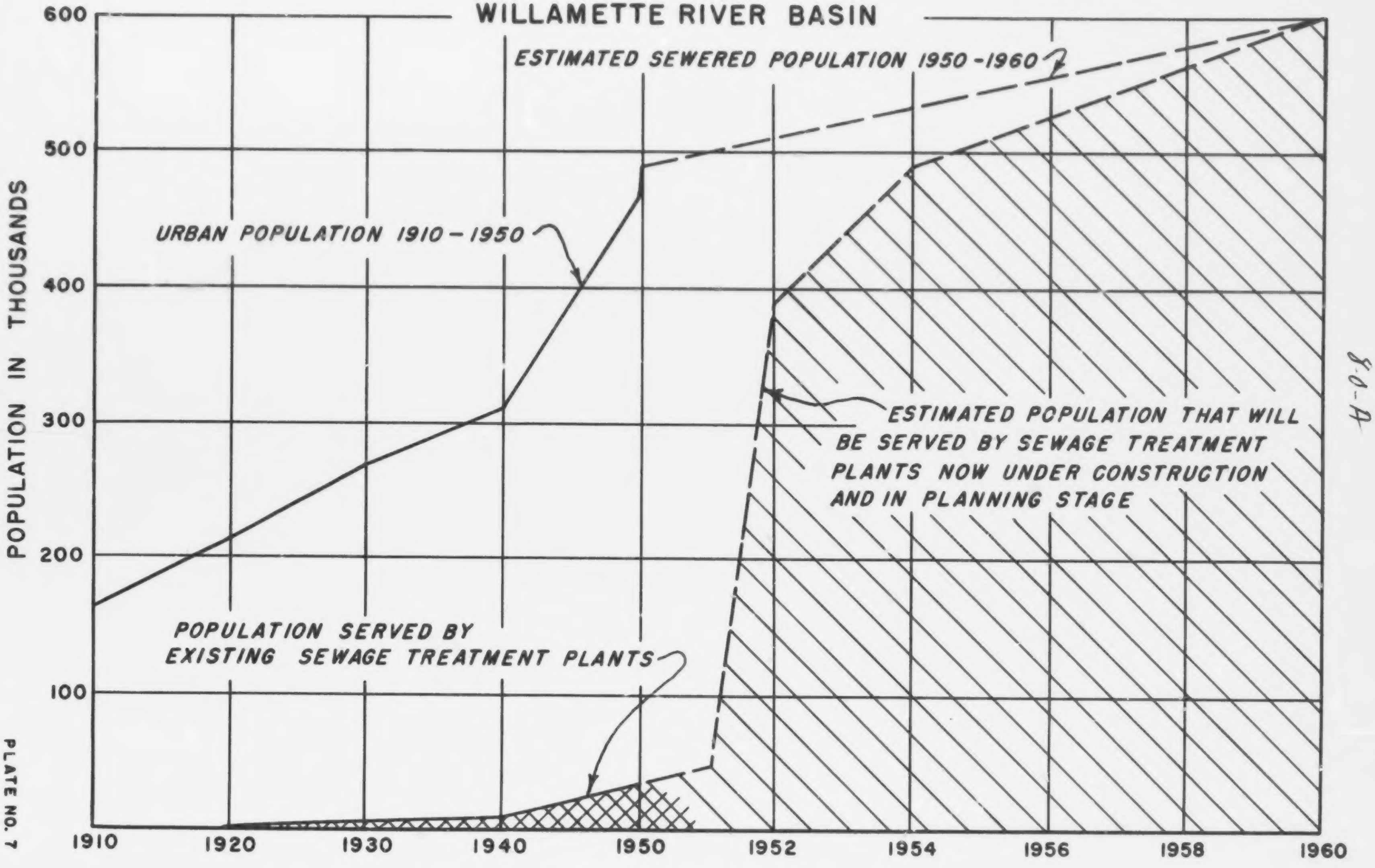


PLATE NO. 7

works. Fifty-five percent of the industrial plants discharge to sewerage systems in municipalities that lack treatment plants; 9 percent are known to discharge directly to streams without treatment; and the disposal methods of 3 percent are unknown and need investigation.[1]

Of the 83 industries discharging wastes through industrially owned facilities,[2] 54 provide treatment prior to discharge, 22 provide no treatment, and the remaining 7 have undetermined facilities. The existing industrial treatment facilities are summarized in Table D.

1/ See Plate 8.

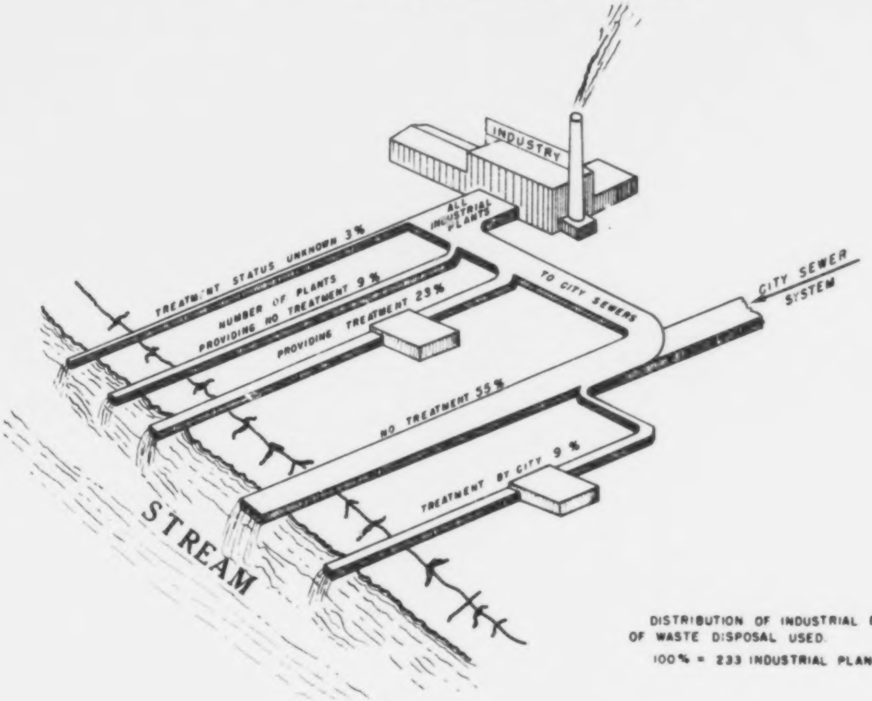
2/ See Map 6 and Appendix 9 -- Table 2.

TABLE D -- EXISTING TREATMENT FACILITIES -- INDUSTRIAL*

		No. of Industrial Plants Having:		
Type of Industry	No. of Plants	Treatment Facilities	No Treat. Facilities	Undeterm. Facilities
Food and Kindred Products:				
Meat Products	26	23	2	1
Dairy Products	5	1	4	0
Canning and Preserving	21	18	2	1
Distillery	1	0	0	1
Textile Mill Products:				
Flax Mills	9	8	1	0
Textile Mills	5	0	3	2
Paper and Allied Products:				
Pulp and Paper Products	6	0	6	0
Paperboard & Other Products	2	1	1	0
Chemical and Allied Products	4	0	2	2
Products of Petroleum & Coal	1	1	0	0
Leather and Leather Products	2	2	0	0
Miscellaneous	1	0	1	0
TOTAL	83	54	22	7

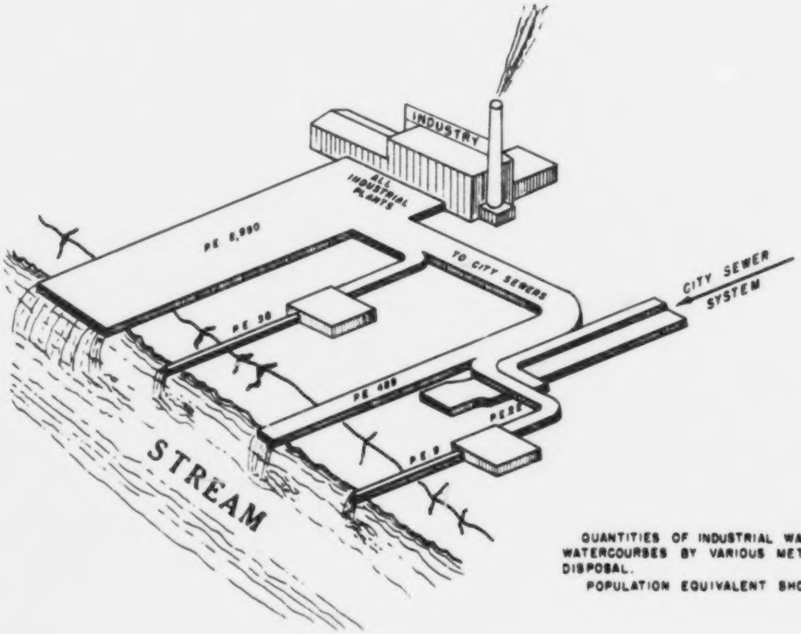
* Industries having separate outlets discharging wastes directly to watercourse.

INDUSTRIAL WASTE DISPOSAL IN THE WILLAMETTE RIVER BASIN


INDUSTRY
ALL INDUSTRIAL PLANTS
TREATMENT STATUS UNKNOWN 3%
NUMBER OF PLANTS PROVIDING NO TREATMENT 9%
PROVIDING TREATMENT 23%
TO CITY SEWERS
CITY SEWER SYSTEM
NO TREATMENT 55%
TREATMENT BY CITY 9%
STREAM

DISTRIBUTION OF INDUSTRIAL PLANTS BY METHOD OF WASTE DISPOSAL USED.

100% = 233 INDUSTRIAL PLANTS.


INDUSTRY
ALL INDUSTRIAL PLANTS
PE 2,990
PE 30
TO CITY SEWERS
CITY SEWER SYSTEM
PE 489
P.E. 2
PE 9
STREAM

QUANTITIES OF INDUSTRIAL WASTES REACHING WATERCOURSES BY VARIOUS METHODS OF WASTE DISPOSAL.

POPULATION EQUIVALENT SHOWN IN THOUSANDS.

PLATE NO. 8

Overall reductions in waste discharges resulting from these anti-pollution measures in effect cannot be stated in specific values at this time. Local watercourse improvement, protection of fish and prevention of nuisances and losses in property values are the clearest evidence that a part of industry at least has joined the movement for clean streams. Until strong oxygen-consuming wastes of the pulp and paper industry are disposed of without river damage, improvements in other industries can be felt only in localized areas.

Serious pollution problems have arisen from the basin's large fruit and vegetable processing industry. Most of the plants are located within municipalities and discharge wastes into city sewers. Salem, alone, has 12 plants of this type. Municipal treatment plants are being designed, or are under construction, to provide treatment for such wastes.

The city of Hillsboro has had in effect since 1946 specific pollution prevention measures for the cannery wastes of the Birds-Eye-Snider Division of the General Foods Corporation. All liquid wastes from this full-line fruit and vegetable canning and freezing plant are piped to a 110-acre farm for use in irrigation. The operation is not only effective in preventing serious pollution, but is almost self-supporting.

The city of Forest Grove has just recently installed a similar method for disposal of wastes from two large canneries, after limited treatment in the municipal plant.

In order to abate pollution, 10 flax-retting plants have constructed lagoons to receive and hold their wastes. Wastes from this important industry were a serious problem in the past.

All pulp and paper mills have installed equipment to reduce losses of wood fiber. In this way a valuable product has been saved, and damages in the form of sludge deposits and increased turbidity have been reduced. Pollution from waste sulphite liquor remains the most serious problem in the Willamette drainage system. Industrial efforts expended so far have not begun to correct conditions resulting from sulphite pulping wastes.

At the Weyerhaeuser Kraft Mill at Springfield, heat and chemical recovery is an inherent part of the pulping process. Even though economical operation requires this production step, freedom from threat of pollution is no less important.

The fact that municipalities and industries have treatment plants, or employ waste prevention or recovery measures, does not necessarily mean that their pollution problems have been solved. Some of the older municipal plants can no longer function effectively. In other communities, increased population, plant obsolescence, or industrial overloading make adequate sewage treatment impossible. Of the 32 treatment plants now in operation, 22 are adequate for the needs of the present populations they serve.1/ Three of the remaining 10 require

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1/ One treatment plant serves 2 municipalities.

enlargements or additions and the other 7 require complete replacements.

Like municipal plants, some of the industrial treatment facilities have become obsolete; however, at a number of plants facilities provided are large enough to treat only a small portion of the total wastes or recover only the readily marketable products contained in the wastes. Of the 54 industrial treatment facilities now in operation, 39 are adequate for present loads. Thirteen of the remaining 15 can be made adequate by suitable additions, enlargements or replacements, but surveys are needed to determine the adequacy of facilities at 2 plants.

The adequacies of existing municipal and industrial treatment facilities are summarized in Tables E and F.

TABLE E -- ADEQUACY OF EXISTING TREATMENT FACILITIES--MUNICIPAL

Number of Municipal* Treatment Facilities	Adequacy with Relation to:					
	Capacity			Operation		
	Satisf.	Unsatisf.	Undeterm.	Satisf.	Unsatisf.	Undeterm.
32	22	10	0	23	8	1

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

TABLE F -- ADEQUACY OF EXISTING TREATMENT FACILITIES -- INDUSTRIAL

Number of Industrial* Treatment Facilities	Adequacy with Relation to:					
	Capacity			Operation		
	Satisf.	Unsatisf.	Undeterm.	Satisf.	Unsatisf.	Undeterm.
54	39	13	2	40	11	3

* Industries having separate outlets discharging wastes directly to watercourse.

Interceptors and treatment facilities estimated to cost 17 million dollars are under construction in the City of Portland. When completed (estimated completion date, 1952), the raw sewage of 294,000 persons[1/] as well as connected industry will be removed from the Willamette River. The Effluent from a 1-1/2 million dollar primary treatment plant serving the entire city will be discharged to the Columbia River.

Following the example set by Portland, other municipalities and industries are actively making plans for sewage and waste treatment, and a number have completed their construction projects. Since 1945, pollution abatement facilities have been constructed by 14 municipalities and 7 industries. Four additional municipal treatment plants, now under construction, will be completed during 1951 and early 1952.

[1/] That portion of Portland's population located in the Willamette River Basin.

TABLE G

PROGRESS IN CONSTRUCTION OF POLLUTION ABATEMENT FACILITIES

Year	Municipal		Industrial	
	Sewage Treatment Plants Completed	Design Population	Waste Treatment Plants Completed	Amount of Waste Treated (P. E.)
1946	0	0	1	35,000
1947	2	1,500	0	0
1948	6	12,250	1	2,000
1949	5	19,600	3	92,000
1950	1	6,000	2	78,000
Under Const.	4	578,000	0	0

Although the primary aim of soil conservation practices is to save soil, these effective measures also reduce turbidity in surface waters. At the present time, more than 200,000 acres are in 3 soil conservation districts where many kinds of conservation work are going on. Included are such activities as contour farming, cover-cropping, seeding of range and pasture, tree planting, and terracing. These are valuable efforts in water as well as soil conservation.

The people of Oregon are in agreement with the general policy to correct pollution. In recognition of the dangers and damages to valuable resources, the public policy, which is to preserve the natural purity of the State's waters was clearly stated in an initiative petition that became law in 1938. It passed by a vote of 247,685 to 75,295.

Measures toward abatement of pollution that have come into effect since establishment of the State Sanitary Authority are tangible results of the public policy. In its operation, the Authority has represented the interests of the public in formulating and translating into action under State laws a program of water resource protection from effects of pollution. Actions in this direction have extended into the fields of investigation, education, planning, persuasion, and legal proceedings. Excellent cooperative working relations have been developed with the Oregon Fish Commission, Oregon Game Commission, Oregon State College, and other agencies.

As would be expected in any area as populous as the Willamette Basin, necessary municipal and industrial efforts toward pollution abatement are not always accomplished by cooperation alone. Occasionally it has been necessary for the Authority to exercise its legal powers in protecting the water resources, and the public health and welfare. On a number of occasions the officials of cities have been summoned before the Authority for the purpose of accelerating action in their lagging abatement programs. During the past 3 years a firm stand by the Authority, and the prospect of legal abatement orders, has led to specific plans and programs at a number of these municipalities. The stream improvement outlook as it relates to community sewage is favorable.

In the industrial field, enforcement action has sometimes been necessary to correct or prevent destructive pollution. Initiation of court proceedings against the Hudson-Duncan Company of Dundee in 1948 was effective in stimulating the provision of necessary facilities for proper disposal of cherry bleach and prune-drying wastes. At Gresham, where the Berry Growers' Association was unable to provide proper treatment for sweet corn processing wastes, an order to cease operation had to be issued in 1948. Although it prevented acceptance of a locally-grown crop worth $150,000, this was the only way in which Johnson Creek could be protected from extremely objectionable pollution.

POLLUTION PREVENTION MEASURES REQUIRED

Specific actions needed in the pollution control program of the Willamette and its tributaries are adequate sewage disposal facilities for all sewered communities, treatment or other satisfactory disposal of industrial wastes, and protection of watershed areas from actions that destroy the water resources.

Surveys now are being conducted by the State Sanitary Authority to obtain information that is now lacking, and for the purposes of evaluating the pollutional discharges from individual industrial plants and estimating the effectiveness of treatment facilities where they exist. Data gathered in these surveys will fill many of the gaps in the present pollution picture and are necessary for complete inclusion and cooperation of industry in the pollution abatement program. By such means, information will be obtained from the industrial plants for which the treatment status is now unknown. It is evident from survey work already done that many unknown polluting industrial plants will be discovered as such work continues.

Production of pulp, paper, and allied products proceeds at a fairly uniform rate throughout the year. Organic wastes with a population equivalent of 2,933,800 are discharged by this industry into the Willamette River System. During high flow periods pollutional effects from this source, as well as all others in the valley, are less objectionable than during summer and fall when there is too little water for dilution. Pulp mill wastes alone would be sufficient to affect some uses of the water at this time. Addition of strong wastes from harvest season industries to the pollution caused by sewage and pulping wastes produces river conditions that are serious and particularly objectionable during the low flow period.

Construction of municipal treatment plants will remove existing hazards to public health and allow for greater freedom in local uses of the water resources. Because wastes from this source are only about 25 percent of the basin total, such abatement measures will not by themselves be sufficient to prevent oxygen depressions in the lower river or make the watercourse system suitable for full expansion of the fishery resources. This can be accomplished only through adequate treatment or other acceptable disposal of all damaging wastes not discharged to city sewers in addition to the municipal wastes.

In the City of Portland, practically all industries now discharging directly to the river will be required to connect to the city system upon completion of the latter. Intercepting sewers will not be constructed along the waterfront industrial area immediately below the city so that petroleum plants and various others located there will continue to dispose of their wastes separately. A gas and coke plant in this group now has limited waste treatment. Because the treatment plant effluent will drain to the Columbia River, industrial and domestic wastes originating in this city will no longer affect the Willamette River except during periods when storm water overflows will reach the river.

Responsibility for pollution control in Portland Harbor is shared by the Sanitary Authority; Corps of Engineers, Department of the Army; and the City of Portland through its Harbor Patrol. Jurisdiction of the Corps of Engineers under Section 13 of the River and Harbor Act of 1899 is limited to protection of the public right of navigation, and under Section 3 of the Oil Pollution Act of 1924 to prevention of pollution resulting from discharge of oil from ships. The Harbor Patrol maintains 3 boats used for patrolling the harbor area, but these are insufficient for the large job to be done. After pollutional conditions in the river above Portland Harbor have been corrected, greater effort will be needed to prevent discharges and spills of oil, chemical wastes, and other substances that are now partially responsible for the unsightly harbor appearance.

The Pollution Control agency must be continually on the alert to prevent new sources of pollution caused by gravel mining, and logging operations. Corrective measures are required for several existing operations of this nature located on tributaries of the Willamette.

Present requirements for pollution abatement in the Willamette River Basin include the construction, enlargement, or replacement of 42 municipal and 29 industrial waste treatment plants. The estimated cost of constructing the municipal plants is $23,500,000 and that of the industrial plants is $9,000,000, a combined total of $32,500,000.

Municipal responsibility includes the construction of 32 new treatment plants. Nineteen of these are required to treat the sewage from 441,050 people and wastes from 129 industries now being discharged to the streams without treatment, and 13 are required to serve a population of 24,600 now living in unsewered communities. In addition to the construction of new plants, 3 existing plants must be enlarged and 7 replaced with modern type facilities.[1/] A summary showing the waste treatment needs of municipalities is shown in Table H.

TABLE H -- WASTE, TREATMENT NEEDS -- MUNICIPAL*

Needs	Number	Population Served By Facilities
New Plant**	32	465,650
Enlargement or Addition to Existing Plant	3	9,600
Replace Existing Plant	7	13,500
No Project Required	22	24,300
Undetermined	0	0

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

** Includes 13 unsewered municipalities which will serve a population of 24,600. (not included in Basic Table 1. See Table M, page 102)

1/ See Map 7.

Present industrial requirements[1] include the construction of new treatment facilities or suitable methods of disposal at 14 industrial establishments, the enlargement or addition of facilities at 6 locations, and the replacement of existing facilities at 7 locations. In addition, two industries must connect to municipal systems. The requirements of 15 other industries are undetermined. Table I gives a summary of the industrial waste pollution abatement needs.

TABLE I — INDUSTRIAL* WASTE POLLUTION ABATEMENT NEEDS

Needs	Number
New Treatment Plant or other Pollution Control Measures	14
Enlargement or Additions to Existing Plant	6
Replace Existing Plant	7
Connection to Municipal Sewer System	2
No project Required	39
Undetermined	15

* Industries having separate outlets discharging wastes directly to watercourse.

Considerable progress has been made since the war toward the eventual construction of treatment facilities by both municipalities and industries. Undoubtedly more projects could have been completed during this 5-year period had the Sanitary Authority desired to place an earlier deadline date for the abatement of pollution in the Willamette River Basin. The Sanitary Authority realized, however, that until Portland could eliminate its sewage from the lower Willamette River the desired stream conditions would not be obtained. Accordingly, and wisely so, it has warned the upstream municipal and industrial offenders to have their treatment plants in operation by 1952, the expected date when Portland would be removing its sewage from the river. This has permitted the municipalities time to prepare plans and arrange for financing their projects, and industries time to study methods for removal of their wastes.

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[1] See Map 8.

Of the 42 municipalities requiring treatment projects, 4 have plants under construction, 7 have final construction plans approved, 21 are actively planning new construction, and 10 are inactive. A number of the latter have been cited to appear before the Sanitary Authority and show cause why no progress has been made. Court action will probably be instituted during 1951 against any municipality which does not take action toward construction of its treatment plant. The current status of municipal action on pollution abatement needs is summarized in Table J, and further illustrated on a sewered population basis in Plate 9.

TABLE J

CURRENT STATUS OF MUNICIPAL ACTION ON POLLUTION ABATEMENT NEEDS

Status of Action	Number of Municipalities*
Inactive	10
Active Planning	21
Final Plans Approved	7
Under Construction	4

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

Of the 29 industries requiring treatment facilities, 9 are actively planning new construction, 18 are inactive and the status of 2 is undetermined. The current status of industrial action on pollution abatement needs is summarized in Table K.

WILLAMETTE RIVER BASIN
MUNICIPAL SEWAGE TREATMENT PROGRAM
BASED ON SEWERED POULATIONS
(Excluding Unsewered Communities)

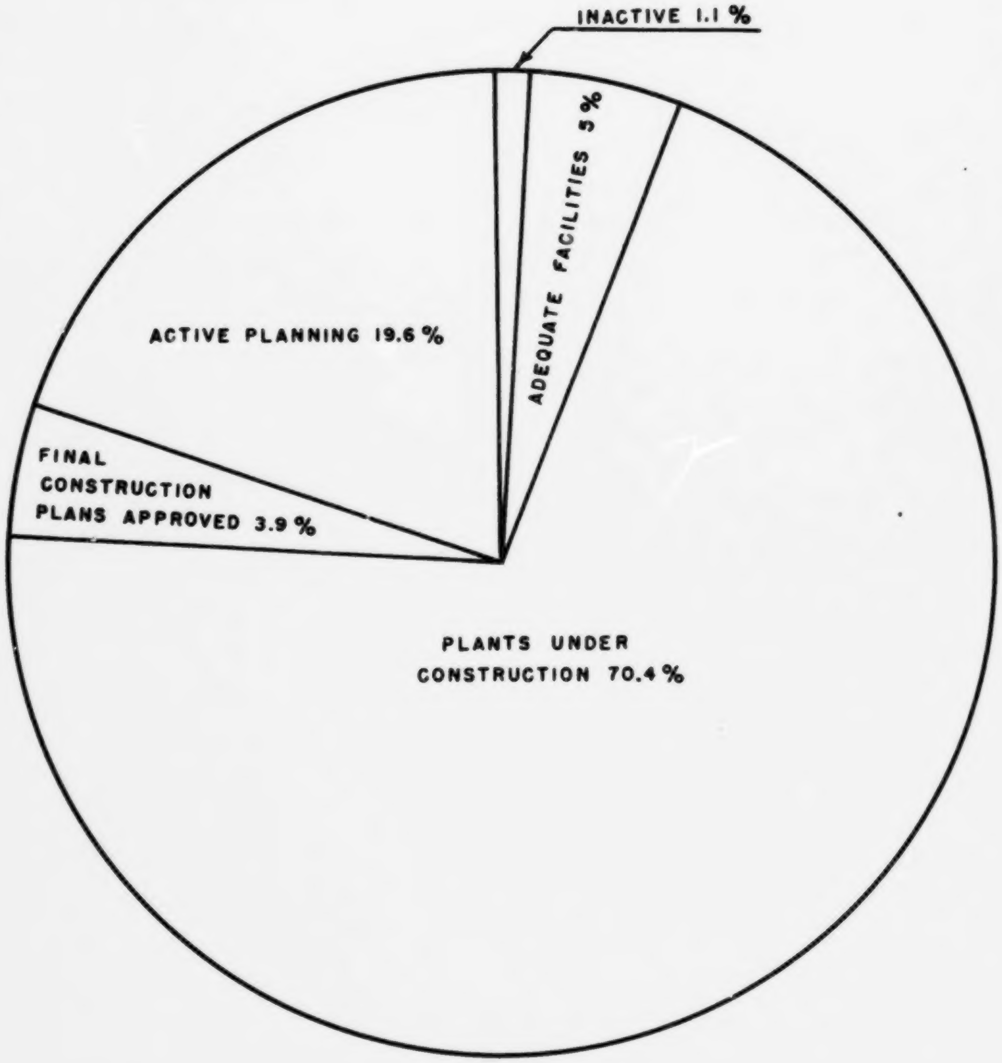

PLATE NO. 9

TABLE K

CURRENT STATUS OF INDUSTRIAL ACTION ON POLLUTION ABATEMENT NEEDS

Status of Action	Number of Industries*
Inactive	18
Active Planning	9
Final Plans Approved	0
Under Construction	0
Undetermined	2

* Industries having separate outlets discharging wastes directly to watercourse.

Orders to abate pollution during the low stream flow period have been issued by the Oregon State Sanitary Authority to 5 sulphite pulp mills. These 5 mills are now actively planning to construct adequate facilities for the disposal of waste sulphite liquor before May 1, 1952, the deadline set by the Authority.

At the Lebanon Mill, the Crown Willamette Pulp and Paper Company has changed recently from calcium base to ammonia base sulphite pulp production and is now conducting research in a full-size pilot plant to determine the feasibility of concentrating and burning the waste sulphite liquor for recovery of heat and chemicals. Results of these studies are most encouraging. They indicate that this type of operation may provide an economical solution to the waste disposal problem of the smaller pulp mills.

It appears that the magnesium base process now in operation in the Weyerhaeuser Timber Company pulp mill at Longview, Washington, will be economical only for the larger size mills.

A list of municipalities and industries needing improvements for abatement of pollution are included in Tables L and M.

TABLE L

MUNICIPALITIES AND INDUSTRIES NEEDING IMPROVEMENTS FOR ABATEMENT OF POLLUTION

DEC. 1950

Name and Location	Population Served[1]	Improvements Needed	Remarks
OREGON			
Albany	24,000	New Plant	— — —
Albany Foods, Inc.	100	Replace Existing Plant	Canning & preserving
Borden Co.	1,000	Connect to City Sewer	Dairy Products
Nebergall Meat Co.	5,600	New Plant	— — —
Steen Bros. Meat Co.	1,450	Replace Existing Plant	— — —
Banks	— — —	— — —	Plant in operation
Bodle Co.	Unknown	New Plant	Canning & Preserving
Kelly Farquhar Co.	Unknown	Replace Existing Plant	Canning & Preserving
Brownsville	500	New Plant	— — —
Brownsville Mills	Unknown	New Plant	Textile Mill
Carlton	830	Replace Existing Plant	— — —
Cedar Mill Park	1,600	Enlarge Existing Plant	— — —

TABLE L (CONTINUED)
Municipalities and Industries Needing Improvements for Abatement of Pollution

Name and Location	Population Served[1]	Improvements Needed	Remarks
Corvallis	40,000	New Plant	— — —
Cottage Grove	3,500	New Plant	— — —
Dallas	6,100	Replace Existing Plant	— — —
Eugene	110,000	New Plant	— — —
Eugene Chemical Co.	Unknown	New Plant	Rendering
Irish McBroom Meat Co.	1,680	Enlarge Existing Plant	— — —
Mayberry Chapman Meat Co.	1,680	Enlarge Existing Plant	— — —
Ore. Turkey Growers	3,600	Enlarge Existing Plant	— — —
Forest Grove	30,000	Replace Existing Plant	— — —
Gaston	— — —	— — —	Plant in operation
Forest Fibre Products	30,000	Replace Existing Plant	Paperboard & Other Prod.
Gladstone	2,000	New Plant	— — —
Gresham	12,000	Enlarge Existing Plant	— — —
Harrisburg	800	New Plant	— — —
Hillsboro	7,500	Enlarge Existing Plant	— — —
H. N. Kumner Meat Co.	2,100	Replace Existing Plant	— — —
Lebanon	10,000	New Plant	— — —
Crown Willamette Co.	109,000	New Plant	Pulp & Paper Products
McMinnville	8,500	New Plant	— — —

TABLE L (CONTINUED)
Municipalities and Industries Needing Improvements for Abatement of Pollution

Name and Location	Population Served[1]	Improvements Needed	Remarks
Milwaukie	5,000	New Plant	— — —
M & S Cannery	570	Replace Existing Plant	— — —
Molalla	1,000	New Plant	— — —
Monroe	300	New Plant	— — —
Benton County Flax Growers	Unknown	Enlarge Existing Plant	— — —
Mt. Angel	3,500	Replace Existing Plant	— — —
Mt. Angel Flax Growers	6,000	New Plant	— — —
Newberg	— — —	— — —	Plant in operation
Spaulding Pulp & Paper Co.	495,000	New Plant	— — —
Oregon City	8,000	New Plant	— — —
Publishers Paper Co.	556,000	New Plant	— — —
Oswego	3,000	New Plant	— — —
Portland	403,000	New Plant	— — —
Pacific Roofing Co.	2,800	New Plant	Roofing Paper
Volney Felt Mills, Inc.	6,000	New Plant	— — —
Portland Gas & Coke Co.	Unknown	Replace Existing Plant	Scrubber Wastes
Salem	250,000	New Plant	— — —
Reid Murdock Co.	32,500	Connect to City Sewer	Canning & Preserving
Oregon Pulp & Paper Co.	860,000	New Plant	— — —
Sheridan	1,000	New Plant	— — —
Springfield	11,500	New Plant	— — —
McKenzie Meat Co.	460	Additions to Existing Plant	— — —

TABLE L (CONTINUED)
Municipalities and Industries Needing Improvements for Abatement of Pollution

Name and Location	Population Served[1/]	Improvements Needed	Remarks
Vermont Hills	350	Replace Existing Plant	— — —
Alpenrose Dairy	Unknown	New Plant	Milk Products
Fulton Park Dairy	Unknown	New Plant	Milk Products
West Linn	2,500	New Plant	— — —
Crown Willamette Co.	831,000	New Plant	Pulp & Paper Products
Woodburn	2,000	Replace Existing Plant	— — —
General Foods, Inc.	50,000	Enlarge Existing Plant	Canning & Preserving
Woodburn School	500	Replace Existing Plant	— — —
TOTAL	3,931,620		

1/ For industries the organic waste load is expressed as population equivalent as measured by B.O.D. For municipalities the industrial waste population equivalent has been added to the population.

TABLE M

MUNICIPALITIES NEEDING BOTH SEWERS AND SEWAGE TREATMENT PLANTS

Municipality	Population To Be Served	Type of Treatment	Status
Canby	2,000	Primary	Final Plans Approved
Cornelius	2,000	Secondary	Active Planning
Dayton	1,400	Secondary	Active Planning
Dunthorpe	1,000	Primary	Inactive
Mill City	1,500	Secondary	Inactive
Oak Grove	5,000	Primary	Inactive
Oakridge	2,000	Primary	Final Plans Approved
Philomath	1,500	Secondary	Active Planning
Sandy*	1,500	Secondary	Active Planning
Stayton	3,000	Primary	Active Planning
Tigard	1,000	Secondary	Inactive
Willamina	2,000	Secondary	Final Plans Approved
Yamhill	700	Secondary	Inactive
TOTAL	24,600		

* Not located in the Basin, but contemplates discharge of the treated effluent to the Clackamas River.

Various references[1] have been made to pollution benefits that would result from flow regulation through summer and fall releases of stored water from Federally-constructed and proposed reservoirs. Such releases undoubtedly will result in localized improvements in water quality. Their effect upon the water quality in the main stem of the Willamette River, however, would not be sufficient to eliminate the necessity for construction of municipal and industrial treatment facilities. They must be considered a supplement to, and not a substitute for, municipal sewage and industrial waste treatment.

As pointed out elsewhere, logging operations already have destroyed or damaged several public water supplies, and action is needed to keep such destruction at a minimum. On Federal, State and municipal lands administrative policies can and are being developed to prevent these conditions, but this is not true of privately-owned land. Road construction in connection with logging operations should be more carefully planned and limited as much as possible. Seeding the roads to grass and leaving strips of brush or timber between logged areas will help prevent erosional pollution, but studies are needed to determine other suitable methods where grass seeding or leaving strips are not possible.

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[1] "Review Report on Columbia River and Tributaries, Appendix J, Willamette River Basin." Part II - Special Studies, Volume II, Corps of Engineers, 1948.
"Willamette Valley Project, A Regional Plan." Oregon State Planning Board. December 21, 1936.
"An Investigation of Fish-Maintenance Problems in Relation to the Willamette Valley Project." Craig, J. A. and Townsend, L. D. Fish and Wildlife Service, Special Scientific Report No. 33. 1946.
"Willamette Valley Project, Oregon, Preliminary Evaluation Report on Fish and Wildlife Resources." Fish and Wildlife Service, Portland, Oregon, 1948.

Bacterial pollution can be prevented by strict supervision over logging crews, and, where possible, by restricting access to municipal supply watersheds. Burning of brush and slashings only when necessary will materially reduce ash pollution.

Particular effort is needed to prevent rejected logs and logging debris from accumulating in stream beds and clogging streams. Many miles of fish rearing streams have been made inaccessible in this way and require governmental clearing at high public cost.

In small financially distressed communities, excessive per capita costs for constructing sewerage facilities to serve limited populations prevent active participation in the pollution abatement program. Although State legislation provides for assistance in disposing of construction bonds, financial assistance in the form of loans at low interest rates, or grants, would accelerate pollution abatement progress by these small communities. Watercourse improvement allows greater beneficial usage by all people of the basin, as well as by other people living in the State. The cost of these improvements under present conditions is borne by the sewered population alone, which comprises only 60 percent of the total basin population, while the benefits go far beyond the populations paying for them. Expenditures of public funds for this type of construction are worthy of consideration.

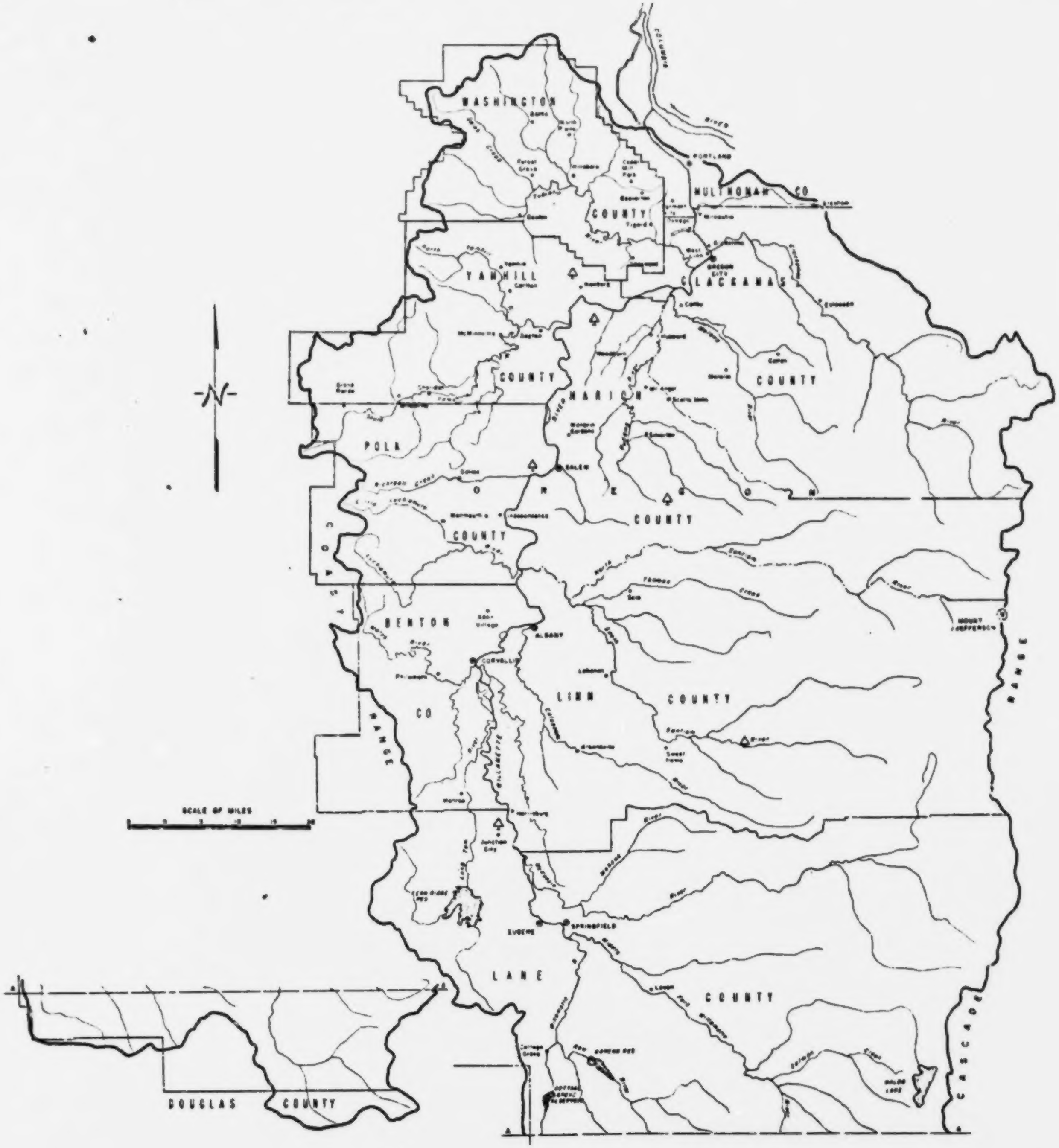
The State's comprehensive program for pollution abatement in the Willamette Basin was evolved about 10 years ago from conditions of watercourse damage, population, and water uses existing at that time. During the past 10 years, population has increased 48 percent, and city sewage loads have increased accordingly. Industry and its wastes have expanded also. Greater demands are made upon the watercourses for water supply, recreation, irrigation, and other uses because the water resources must be shared by more people. There are demands for new kinds of water uses and expansion of old ones. A growing fleet of pleasure craft, owned by Willamette Basin residents, is moored on the Columbia River where the boats were driven by pollution. They will come back to the Willamette whenever it is fit to use. Existing clean waters above sources of pollution will not continue to supply enough areas for recreation; and others must be made suitable for use near population centers.

The fishery resources must be expanded to compensate for loss of salmon producing areas elsewhere, and because the number of sport fishermen increases faster than the population.

These developments mean that the pattern of the abatement program cannot be static, but must be conditioned by the ratio between costs and the benefits to be derived. Many of the basin cities are now engaged in plans or construction of primary treatment plants that are expected to improve water conditions to the extent needed for normal water uses that can be foreseen. Watercourse improvement may lead to resumption and tremendous expansion of recreational or other uses so that further sewage treatment may become justified. It is inevitable that some time in the future, as economic growth progresses, secondary treatment units must be added to maintain the river improvements obtained by the present abatement program.

With respect to progress of the present pollution abatement program, in most cases corrective measures are installed as rapidly as municipal finances will permit. When pollution from all major sources has been suitably corrected, new legislation will be needed to facilitate control over new potential sources of pollutional discharges. This could be accomplished by legal provision of specific penalties for resource damages so that pollution will be forestalled or corrected rapidly. Each day of violation should be defined as a separate offense subject to cumulative penalty.

Legislation requiring possession of a permit issued by the Sanitary Authority as a preliminary to any discharge to a watercourse will stimulate closer cooperative relationships with communities and industry and will provide current knowledge of pollution and corrective measures needed. As applied to establishment of new industry, application for permit prior to construction of the industrial plant should be legally required. Such permits should cover a limited period of time, require formal renewal and should specify the quantity and character of the discharge concerned.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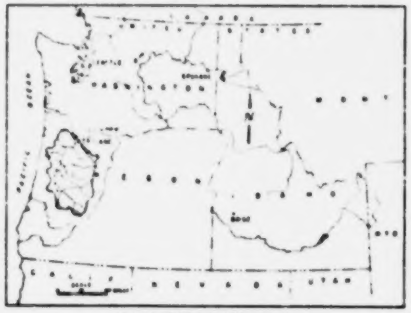
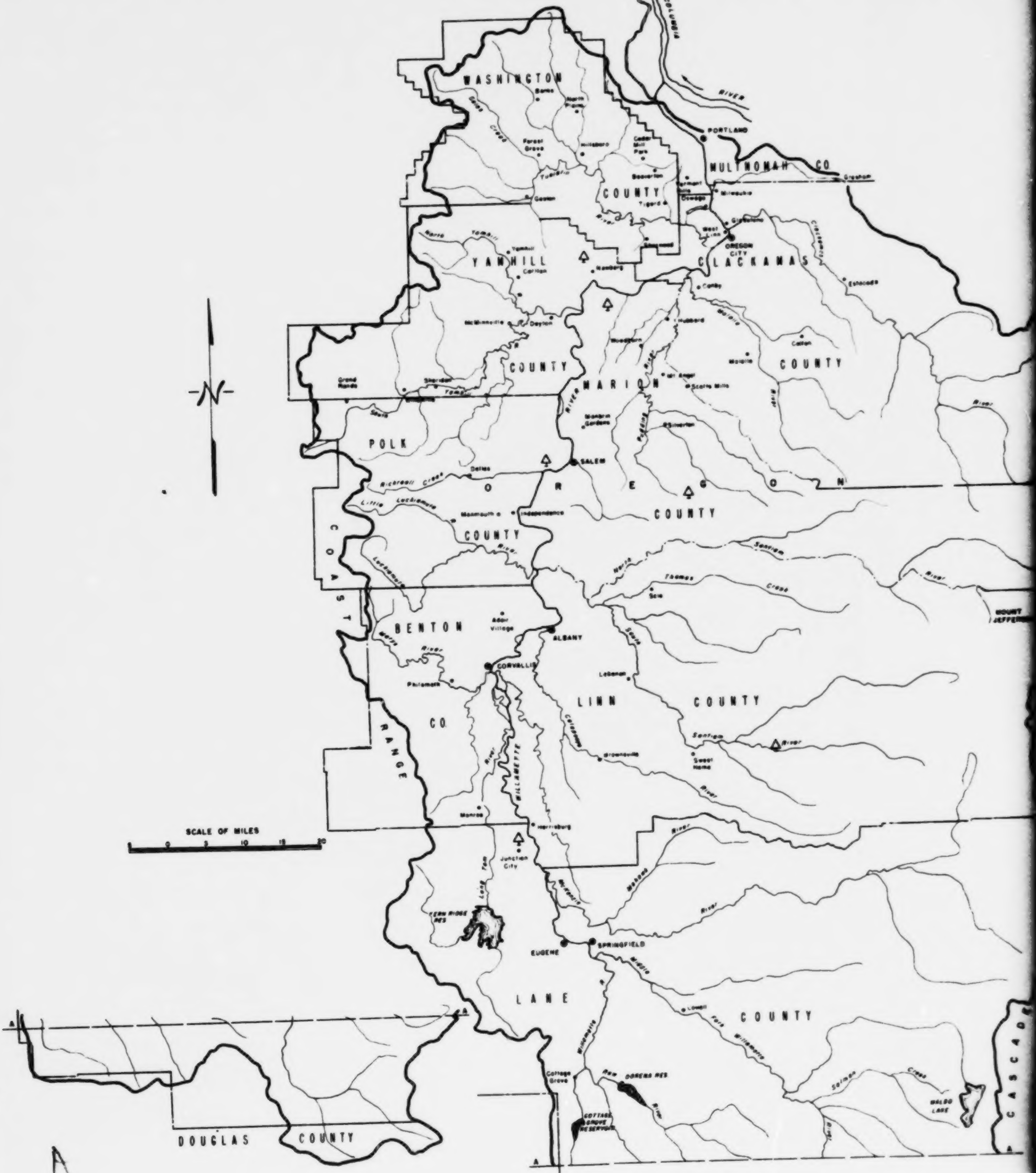


WILLAMETTE RIVER BASIN
LOCATION MAP

WILLAMETTE RIVER BASIN
GENERAL REFERENCE MAP

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP No. 1

WASHINGTON
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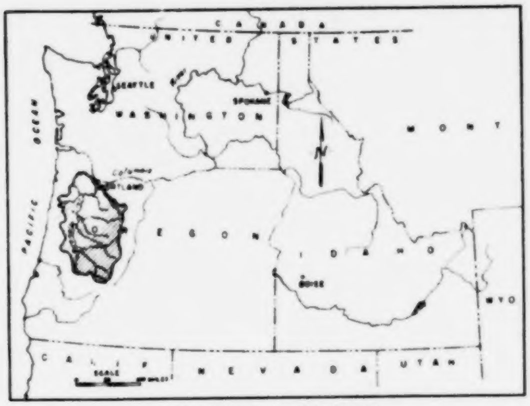
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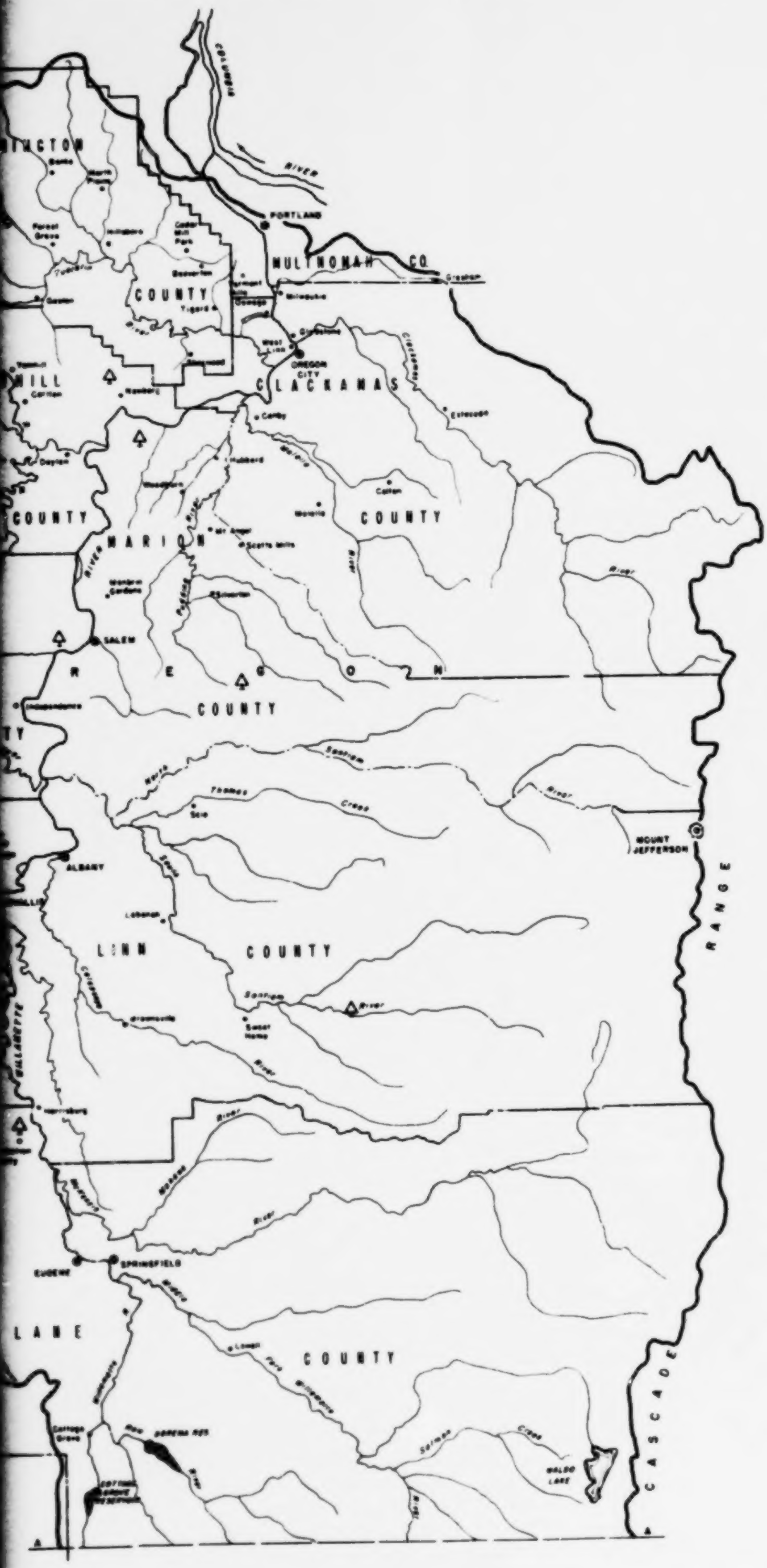
WILLAMETTE RIVER BASIN
LOCATION MAP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SPRINGFIELD
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Cottage Grove
Row River
DORENA RES
COTTAGE GROVE RESERVOIR
Salmon Creek
WALDO LAKE
CASCADE RANGE

△ STATE PARK

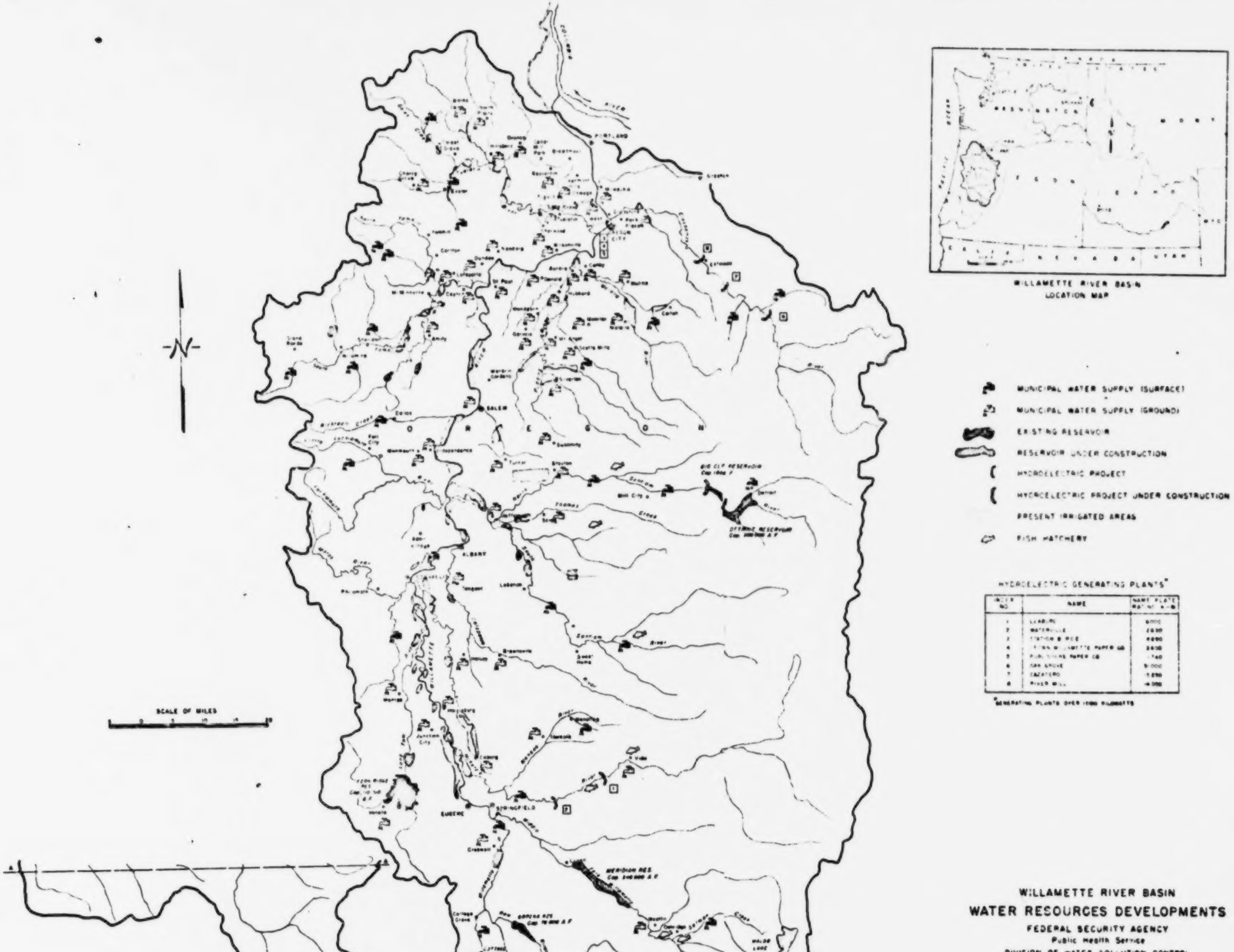
WILLAMETTE RIVER BASIN

GENERAL REFERENCE MAP

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP No. 1

B


WILLAMETTE RIVER BASIN
LOCATION MAP
MUNICIPAL WATER SUPPLY (SURFACE)
MUNICIPAL WATER SUPPLY (GROUND)
EXISTING RESERVOIR
RESERVOIR UNDER CONSTRUCTION
HYDROELECTRIC PROJECT
HYDROELECTRIC PROJECT UNDER CONSTRUCTION
PRESENT IRRIGATED AREAS
FISH HATCHERY
HYDROELECTRIC GENERATING PLANTS*
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*GENERATING PLANTS OVER 1000 KILOWATTS
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ALBANY
EUGENE
SPRINGFIELD
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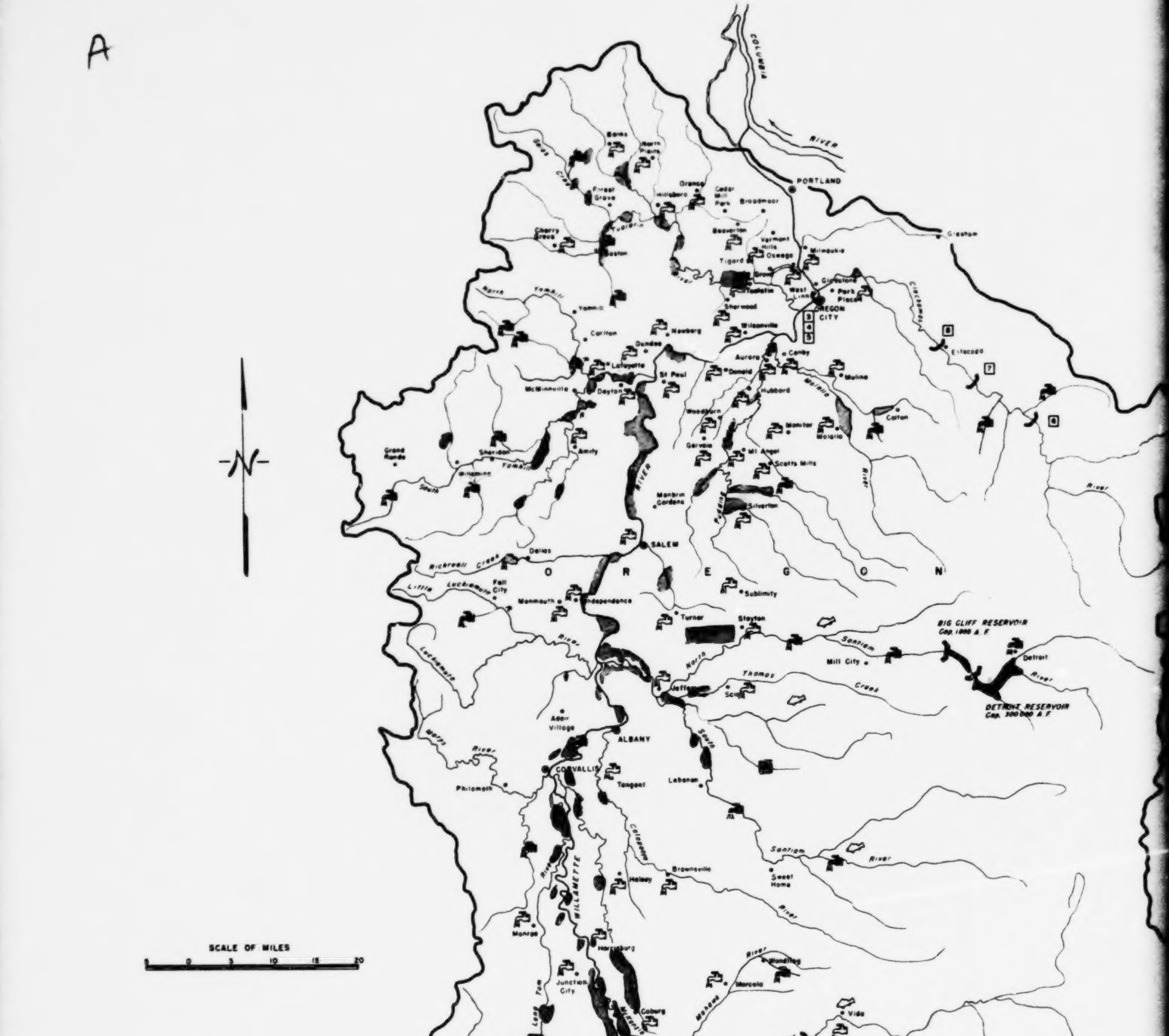
MERIDIAN RES.
DETROIT RESERVOIR
BIG CLIFF RESERVOIR
WALDO LAKE
COLUMBIA RIVER

WILLAMETTE RIVER BASIN
WATER RESOURCES DEVELOPMENTS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP No. 2

A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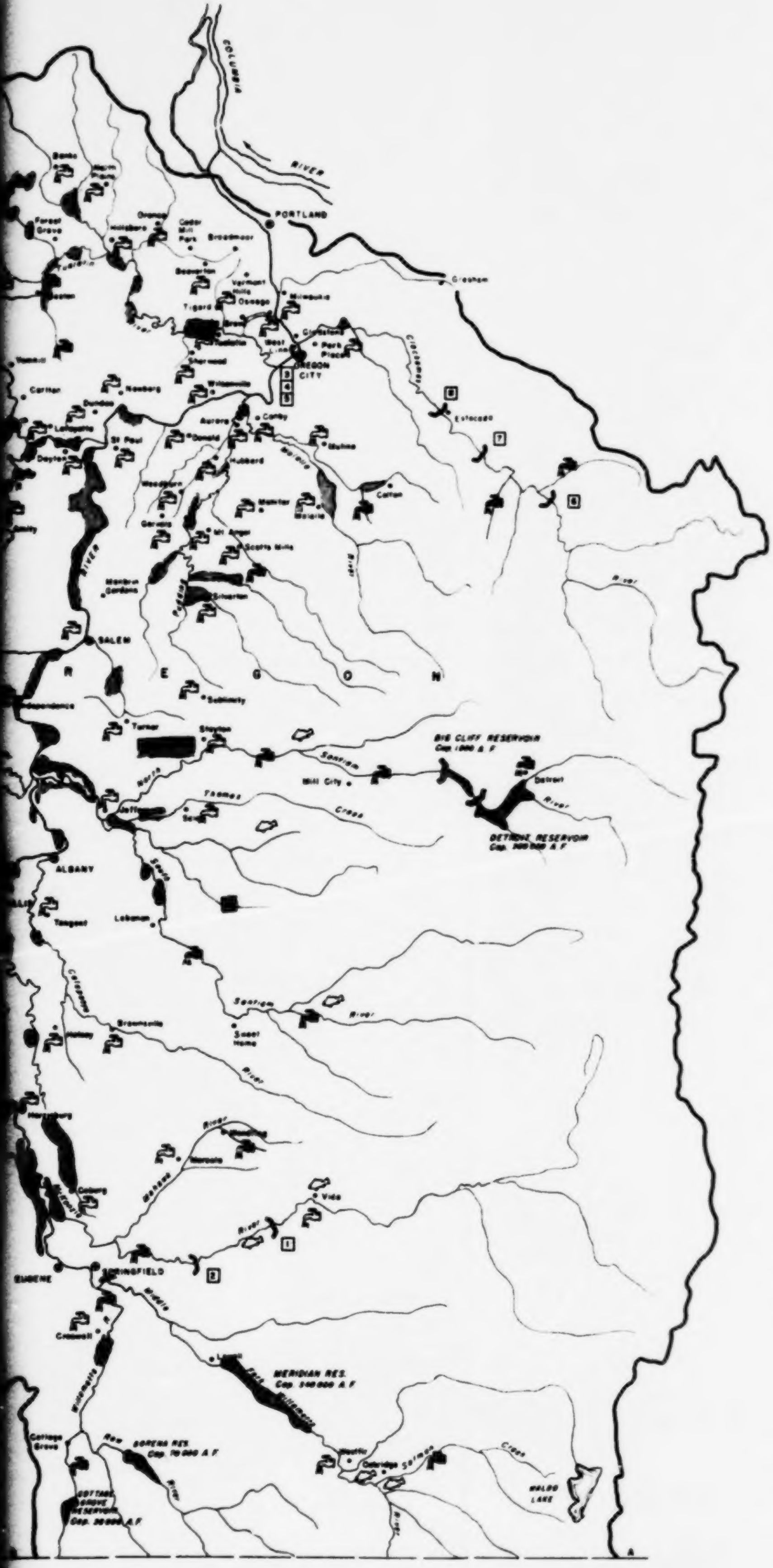
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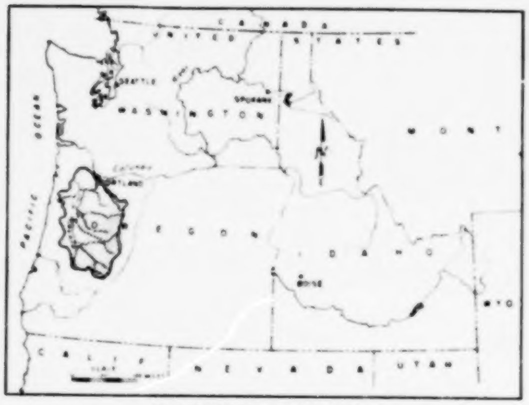
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WILLAMETTE RIVER BASIN
LOCATION MAP

- MUNICIPAL WATER SUPPLY (SURFACE)
- MUNICIPAL WATER SUPPLY (GROUND)
- EXISTING RESERVOIR
- RESERVOIR UNDER CONSTRUCTION
- HYDROELECTRIC PROJECT
- HYDROELECTRIC PROJECT UNDER CONSTRUCTION
- PRESENT IRRIGATED AREAS
- FISH HATCHERY

HYDROELECTRIC GENERATING PLANTS*

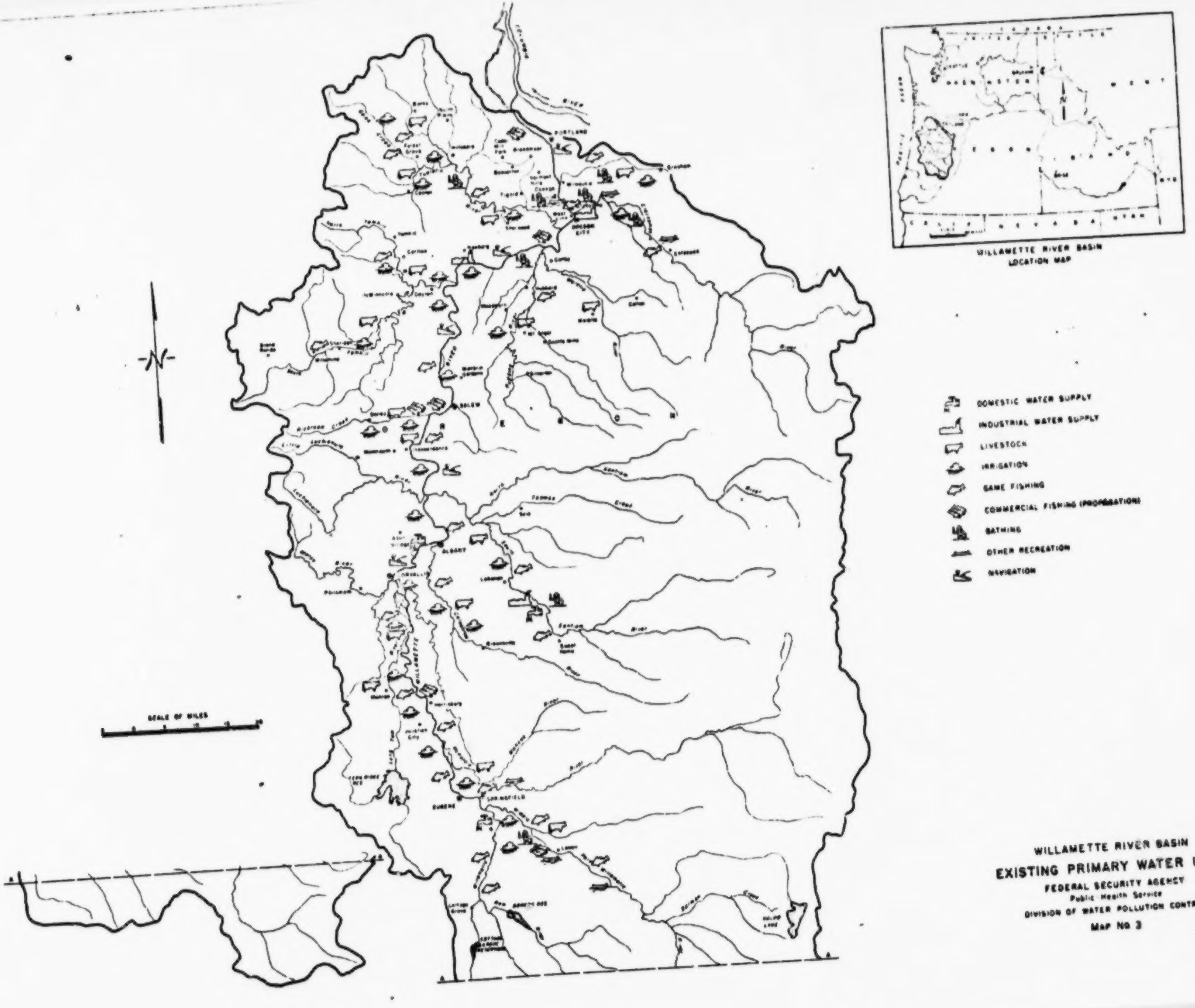
INDEX NO.	NAME	NAME PLATE RATING K-W
1	LEABURG	6000
2	WATERVILLE	2630
3	STATION B P G E	4890
4	CROWN WILLAMETTE PAPER CO	3800
5	PUBLISHERS PAPER CO	1740
6	OAK GROVE	51000
7	CAZADERO	15250
8	RIVER MILL	14050

*GENERATING PLANTS OVER 1000 KILOWATTS

WILLAMETTE RIVER BASIN
WATER RESOURCES DEVELOPMENTS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO. 2


WILLAMETTE RIVER BASIN
LOCATION MAP
DOMESTIC WATER SUPPLY
INDUSTRIAL WATER SUPPLY
LIVESTOCK
IRRIGATION
GAME FISHING
COMMERCIAL FISHING (PROPAGATION)
BATHING
OTHER RECREATION
NAVIGATION
SCALE OF MILES
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Forest Grove
Hillsboro
Beaverton
Tigard
Oswego
Milwaukie
OREGON CITY
West Linn
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Silverton
Independence
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Lebanon
Brownsville
Sweet Home
Corvallis
Junction City
Harrisburg
SPRINGFIELD
EUGENE
Cottage Grove
Odell Lake

WILLAMETTE RIVER BASIN

EXISTING PRIMARY WATER USES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP No 3

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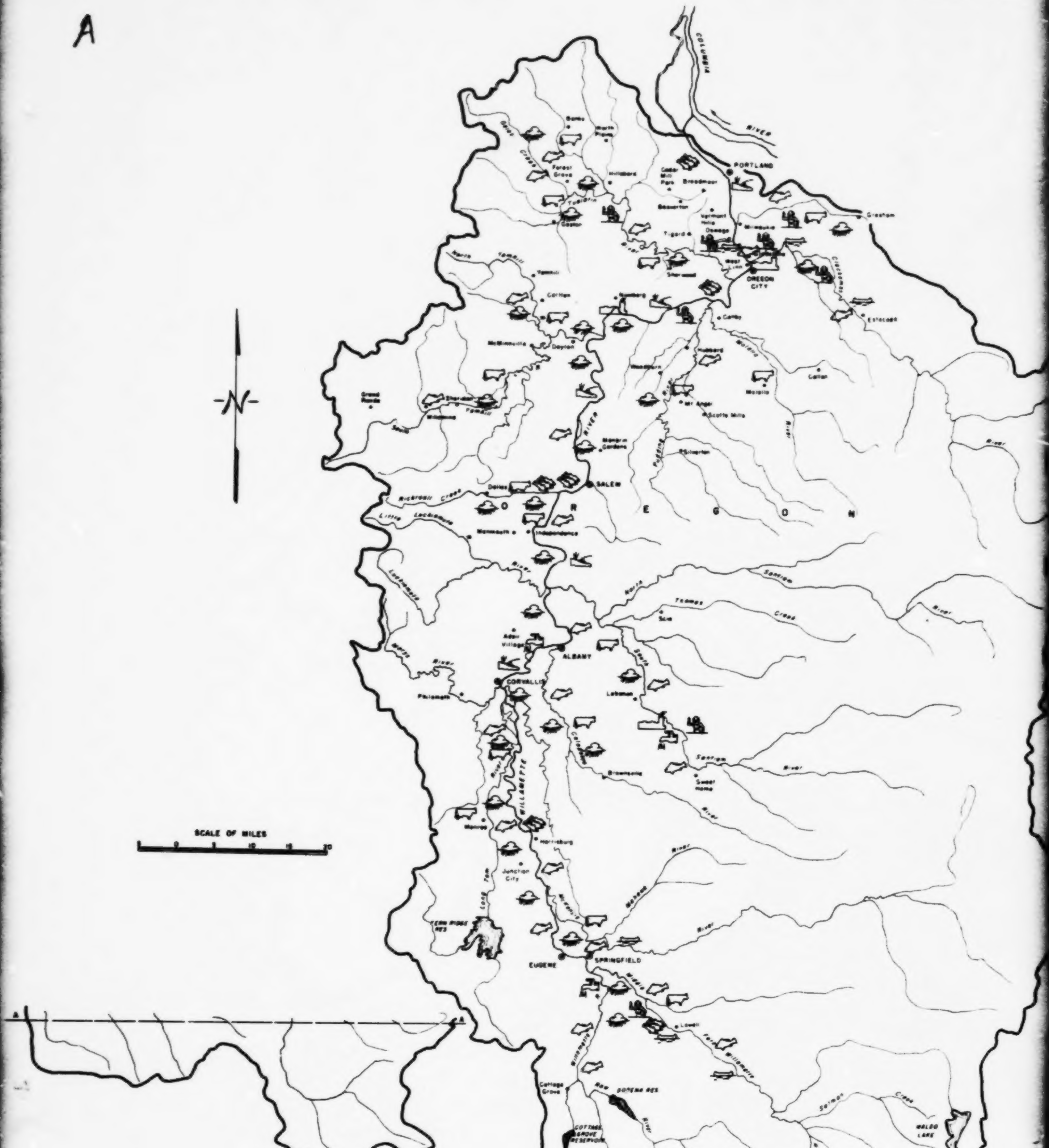

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Scio
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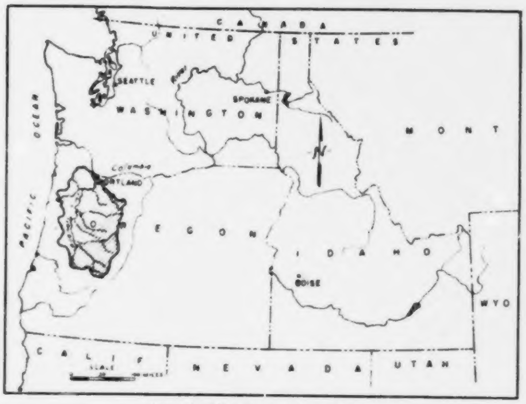
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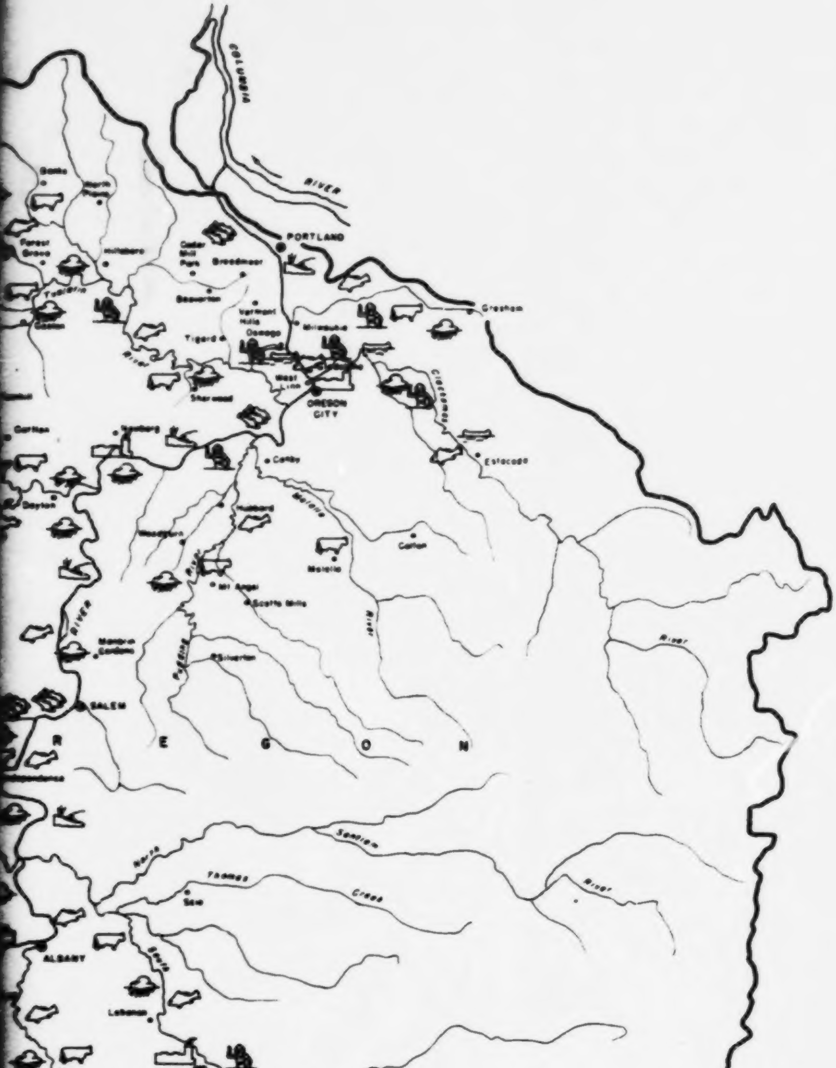
WILLAMETTE RIVER BASIN
LOCATION MAP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DORENA RES.
COTTAGE GROVE RESERVOIR
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Salmon Creek
WALDO LAKE
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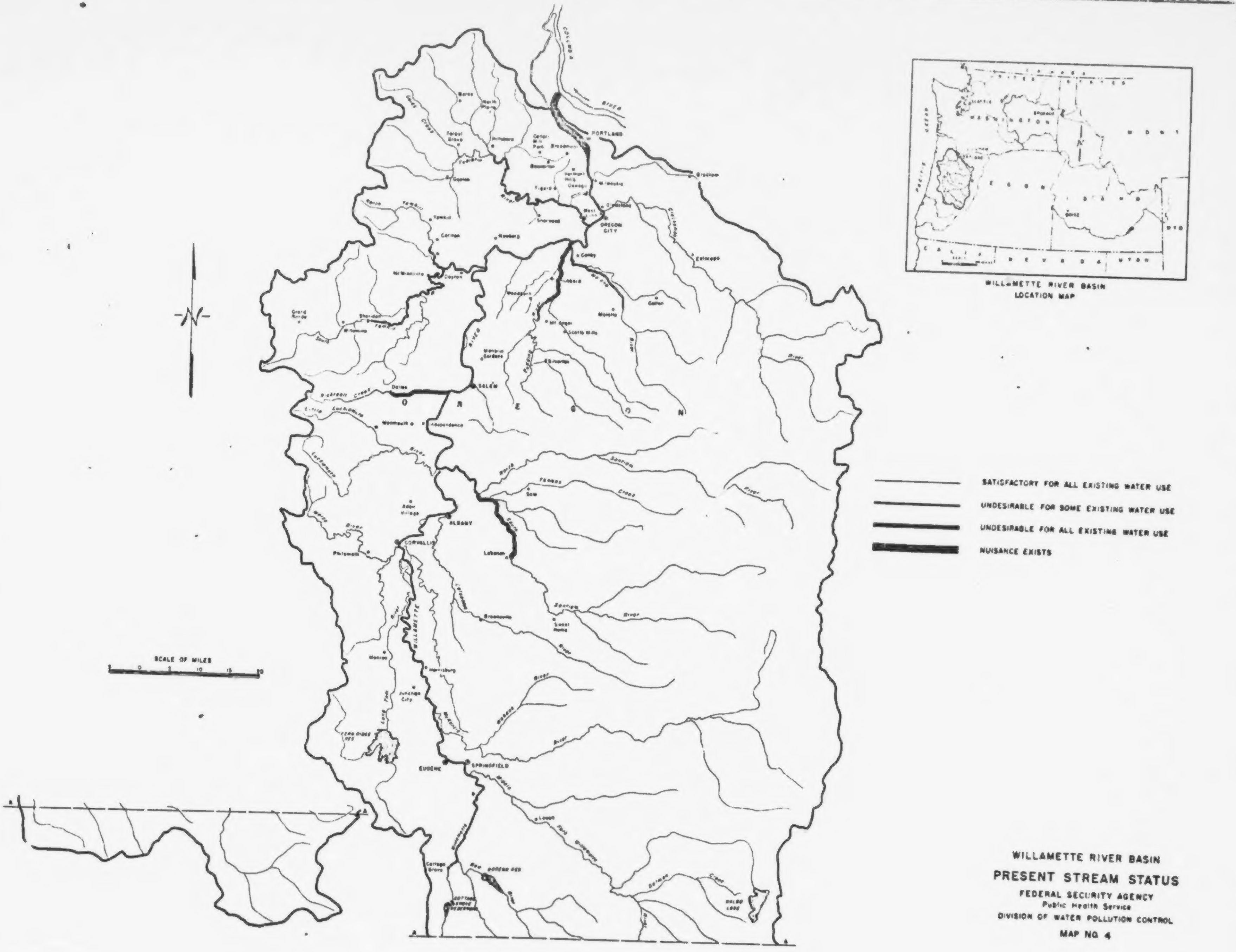
DOMESTIC WATER SUPPLY
INDUSTRIAL WATER SUPPLY
LIVESTOCK
IRRIGATION
GAME FISHING
COMMERCIAL FISHING (PROPAGATION)
BATHING
OTHER RECREATION
NAVIGATION

WILLAMETTE RIVER BASIN
EXISTING PRIMARY WATER USES
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP No. 3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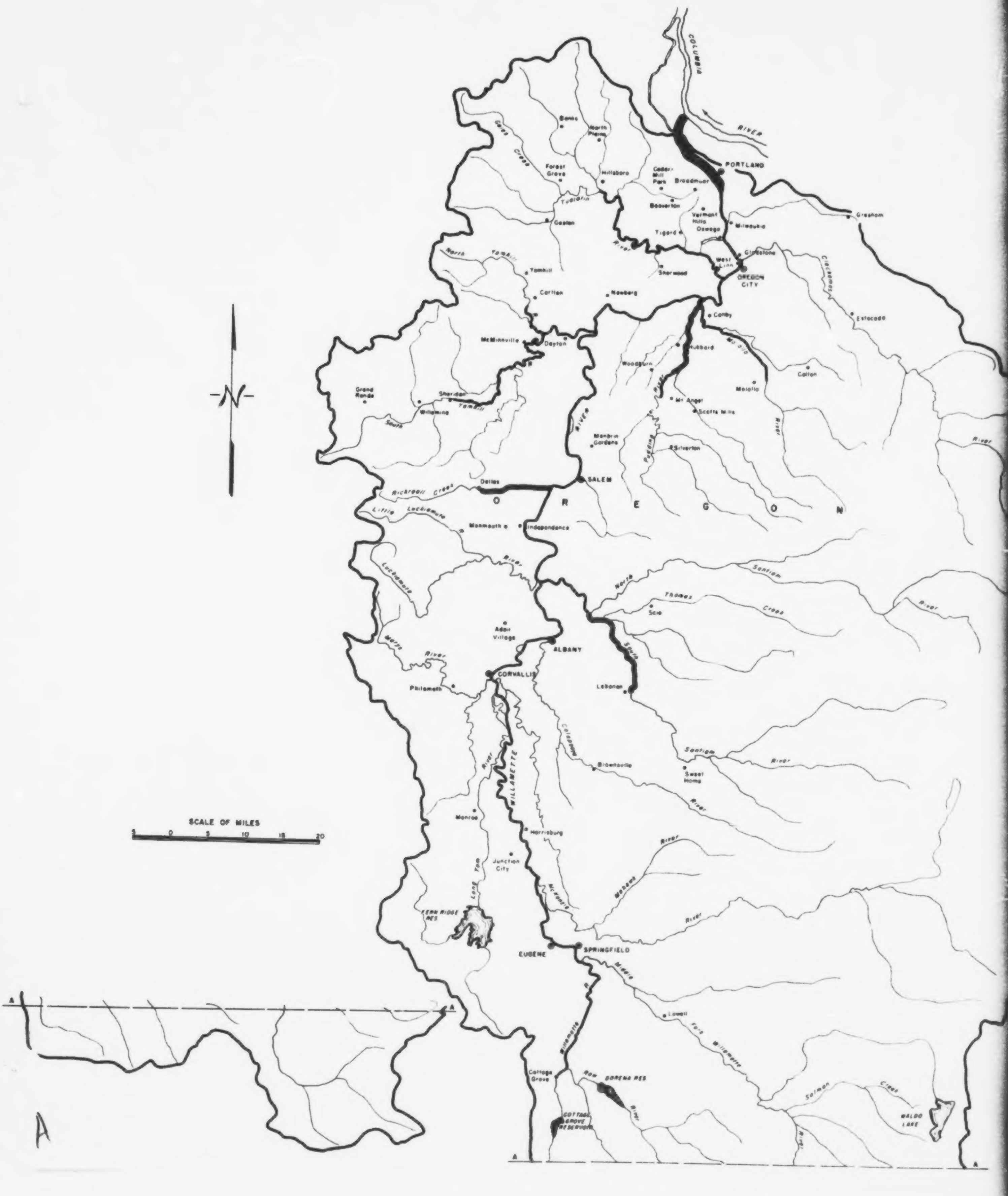
Monmouth
Independence
Adair Village
Scio
Lebanon
Sweet Home
Brownsville
Philomath
Monroe
Harrisburg
Junction City
Fern Ridge Res
Cottage Grove
Lowell
Waldo Lake
Santiam
Calapooya
Luckiamute
Mohawk
McKenzie
SATISFACTORY FOR ALL EXISTING WATER USE
UNDESIRABLE FOR SOME EXISTING WATER USE
UNDESIRABLE FOR ALL EXISTING WATER USE
NUISANCE EXISTS
SCALE OF MILES
0 5 10 15 20
WASHINGTON
OREGON
IDAHO
NEVADA
UTAH
MONT
PACIFIC OCEAN
Boise
WILLAMETTE RIVER BASIN
LOCATION MAP

WILLAMETTE RIVER BASIN

PRESENT STREAM STATUS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO. 4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Oswego
Milwaukie
Gresham
Tualatin
Gaston
Tigard
River
North Yamhill
Yamhill
Sherwood
West Linn
Gladstone
OREGON CITY
Clackamas
Carlton
Newberg
Canby
Estacada
McMinnville
Dayton
R
Hubbard
Molalla
Woodburn
Colton
Grand Ronde
Sheridan
Yamhill
Willamina
South
Pudding
River
Mt Angel
Scotts Mills
Molalla
River
River
Manbrin Gardens
Silverton
SALEM
Dallas
Rickreall Creek
O R E G O N
Little Luckiamute
Monmouth
Independence
River
Luckiamute
North
Santiam
Thomas
Creek
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River
Adair Village
Marys
River
ALBANY
South
CORVALLIS
Philomath
Lebanon
Calapooya
Brownsville
Santiam
River
Sweet Home
River
WILLAMETTE
SCALE OF MILES
5 0 5 10 15 20
Monroe
Harrisburg
River
Junction City
Long Tom
McKenzie
Mohawk
River
FERN RIDGE RES
EUGENE
SPRINGFIELD
Middle
R
A
A
Lowell
Fork
Willamette
Willamette
Cottage Grove
Row
DORENA RES
River
COTTAGE GROVE RESERVOIR
Salmon
Creek
WALDO LAKE
River
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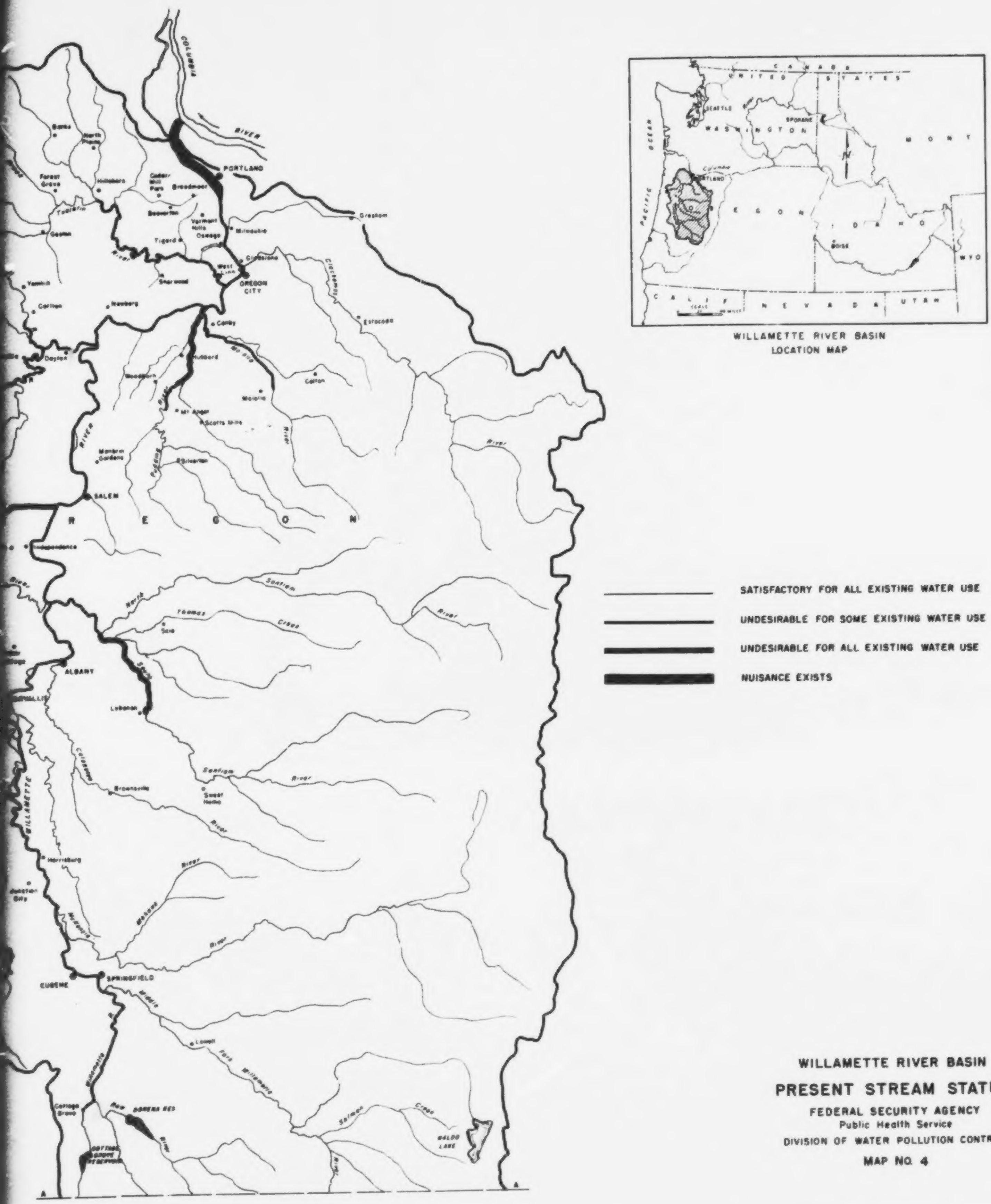
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Broadmoor
Beaverton
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Oswego
Tigard
Milwaukie
Gresham
Gaston
Tualatin
River
Gladstone
West Linn
OREGON CITY
Sherwood
Yamhill
Carlton
Newberg
Canby
Estacada
Clackamas
Dayton
Hubbard
Woodburn
Molalla
Colton
Mt Angel
Scotts Mills
Pudding
River
Silverton
Monitor Gardens
SALEM
O R E G O N
Independence
North
Santiam
Thomas
Creek
Scio
ALBANY
South
Lebanon
Santiam
River
Sweet Home
Brownsville
Calapooia
WILLAMETTE
Harrisburg
Junction City
Mohawk
River
McKenzie
EUGENE
SPRINGFIELD
Middle
Fork
Willamette
Lowell
Cottage Grove
Row
DORENA RES
COTTAGE GROVE RESERVOIR
Salmon
Creek
WALDO LAKE
A
A
C A N A D A
UNITED STATES
SEATTLE
SPOKANE
WASHINGTON
PACIFIC OCEAN
Columbia
PORTLAND
O R E G O N
I D A H O
BOISE
MONT
WYO
CALIF
N E V A D A
UTAH
SCALE
WILLAMETTE RIVER BASIN
LOCATION MAP

─	SATISFACTORY FOR ALL EXISTING WATER USE
━	UNDESIRABLE FOR SOME EXISTING WATER USE
▬	UNDESIRABLE FOR ALL EXISTING WATER USE
█	NUISANCE EXISTS

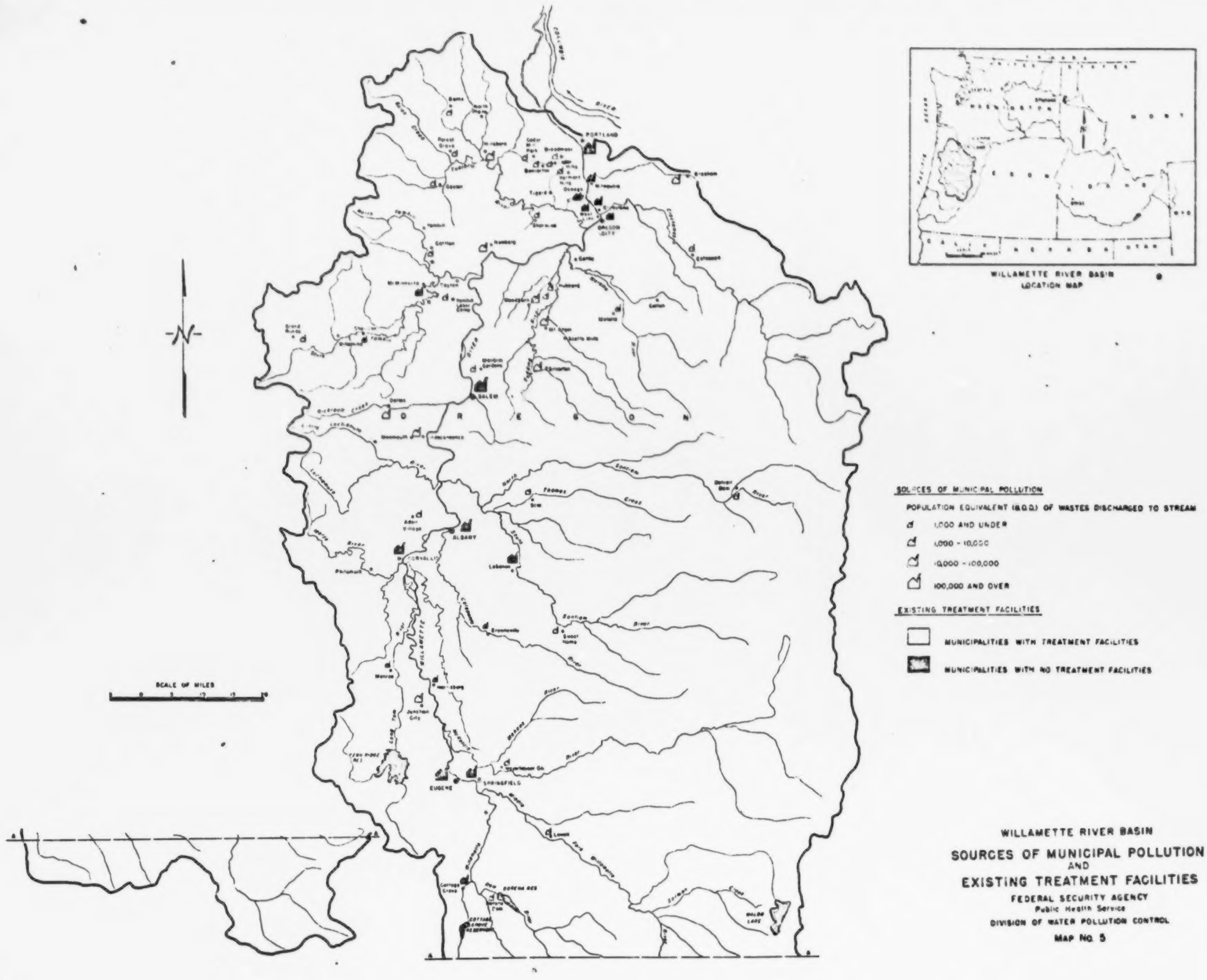
WILLAMETTE RIVER BASIN

PRESENT STREAM STATUS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO. 4

B

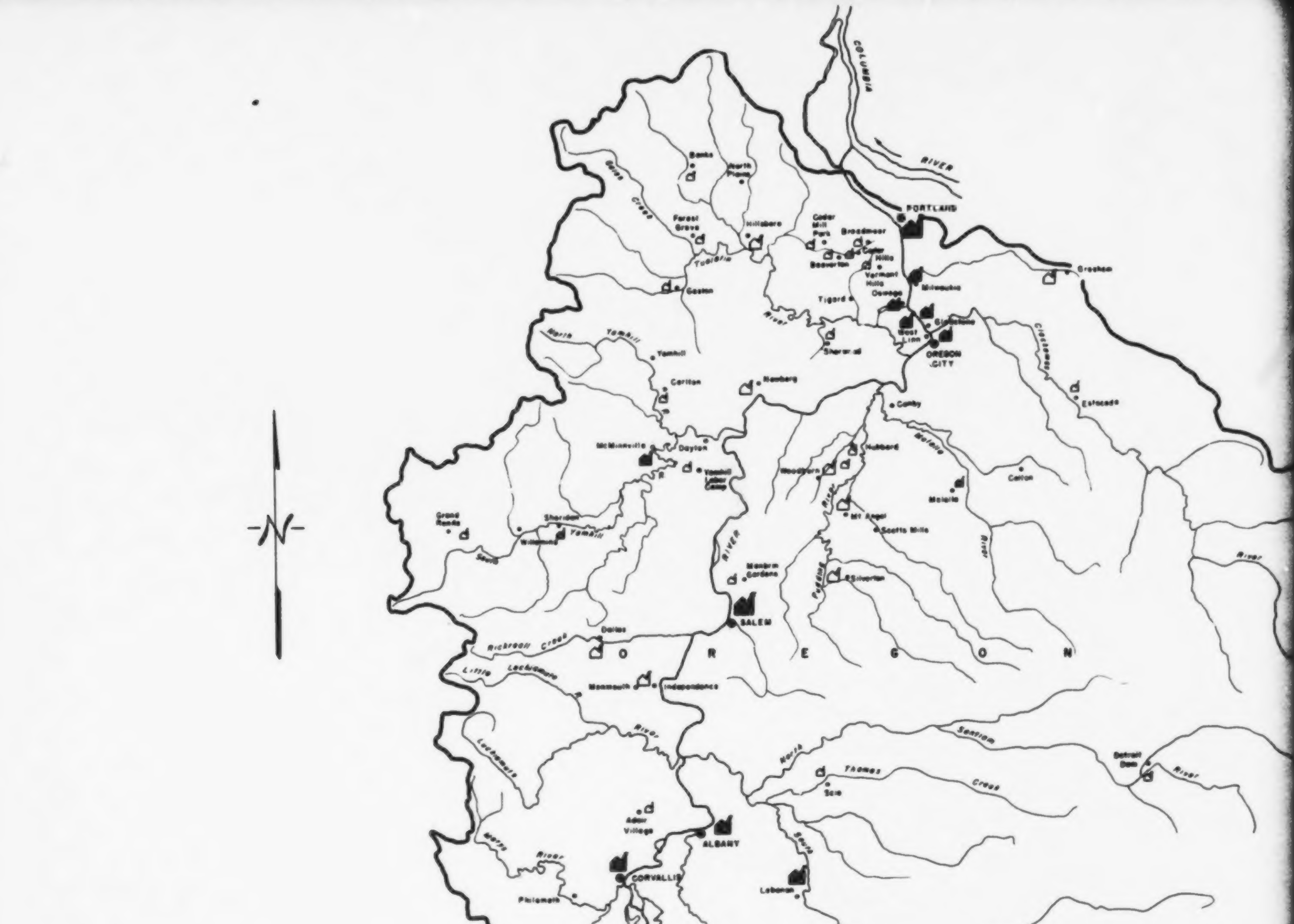

COLUMBIA RIVER
PORTLAND
Gresham
Hillsboro
Forest Grove
Beaverton
Tigard
Oswego
Milwaukie
OREGON CITY
Estacada
Newberg
Sherwood
SALEM
Dallas
Monmouth
O R E G O N
ALBANY
Lebanon
CORVALLIS
Philomath
Sweet Home
WILLAMETTE
Junction City
EUGENE
SPRINGFIELD
Lowell
Cottage Grove
SCALE OF MILES
WILLAMETTE RIVER BASIN
LOCATION MAP
SOURCES OF MUNICIPAL POLLUTION
POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED TO STREAM
1,000 AND UNDER
1,000 - 10,000
10,000 - 100,000
100,000 AND OVER
EXISTING TREATMENT FACILITIES
MUNICIPALITIES WITH TREATMENT FACILITIES
MUNICIPALITIES WITH NO TREATMENT FACILITIES

WILLAMETTE RIVER BASIN

SOURCES OF MUNICIPAL POLLUTION
AND
EXISTING TREATMENT FACILITIES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO. 5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Banks
North Plains
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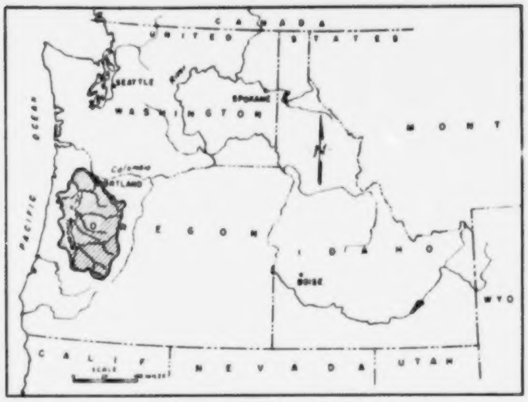
Forest Grove
Hillsboro
Cedar Mill Park
Broadmoor
Cedar Hills
Beaverton
Vermont Hills
Oswego
Milwaukie
Gresham
Tualatin
Gaston
Tigard
River
Gladstone
West Linn
OREGON CITY
Sherwood
North Yamhill
Yamhill
Carlton
Newberg
Clackamas
Estacada
Canby
McMinnville
Dayton
Yamhill Labor Camp
Molalla
Hubbard
Woodburn
Colton
Mt Angel
Scotts Mills
Grand Ronde
Sheridan
Willamina
Yamhill
South
RIVER
Meadow Gardens
Pudding
Silverton
SALEM
Dallas
Rickreall Creek
O R E G O N
Little Luckiamute
Monmouth
Independence
River
Luckiamute
North
Santiam
Thomas
Creek
Scio
Detroit Dam
River
Adair Village
ALBANY
Marys
River
CORVALLIS
Philomath
South
Lebanon
Calapooia
Brownsville
Santiam
River
Sweet Home
River
WILLAMETTE
River
Monroe
Harrisburg
Junction City
Long
FERN RIDGE RES
Mohawk
Mohawk
River
Weyerhaeuser Co.
River
EUGENE
SPRINGFIELD
Middle
R.
Lowell
Fork Willamette
Willamette
Cottage Grove
Row
DORENA RES
Dorena Dam
River
COTTAGE GROVE RESERVOIR
Salmon
Creek
WALDO LAKE
River
A
A
A
A
N
SCALE OF MILES
0
5
10
15
20

A


CANADA
UNITED STATES
SEATTLE
SPOKANE
WASHINGTON
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PACIFIC OCEAN
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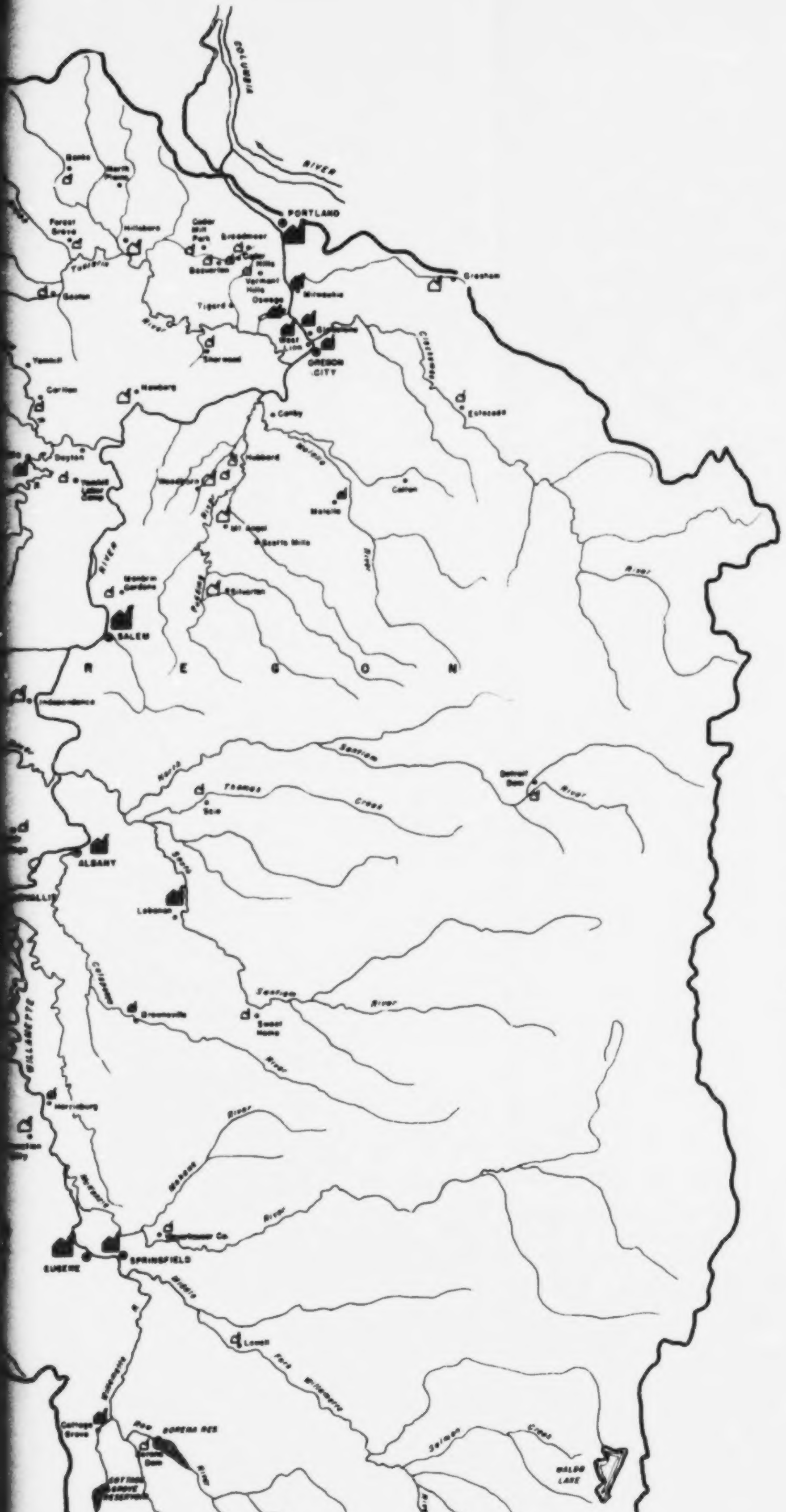
OREGON
IDAHO
BOISE
WYO
CALIF
NEVADA
UTAH

WILLAMETTE RIVER BASIN
LOCATION MAP


COLUMBIA RIVER
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Forest Grove
Hillsboro
Beaverton
Milwaukie
Tigard
Oswego
West Linn
OREGON CITY
Sherwood
Newberg
Carlton
Canby
Estacada
Dayton
Hubbard
Woodburn
Molalla
Mt Angel
Silverton
SALEM
Independence
North Santiam River
Detroit Dam
ALBANY
Lebanon
Brownsville
Sweet Home
Santiam River
Harrisburg
EUGENE
SPRINGFIELD
McKenzie River
Lowell
Middle Fork Willamette
Cottage Grove
Dorena Res
Salmon Creek
Waldo Lake
OREGON

SOURCES OF MUNICIPAL POLLUTION

POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED TO STREAM

⌂	1,000 AND UNDER
⌂	1,000 - 10,000
⌂	10,000 - 100,000
⌂	100,000 AND OVER

EXISTING TREATMENT FACILITIES

☐	MUNICIPALITIES WITH TREATMENT FACILITIES
■	MUNICIPALITIES WITH NO TREATMENT FACILITIES

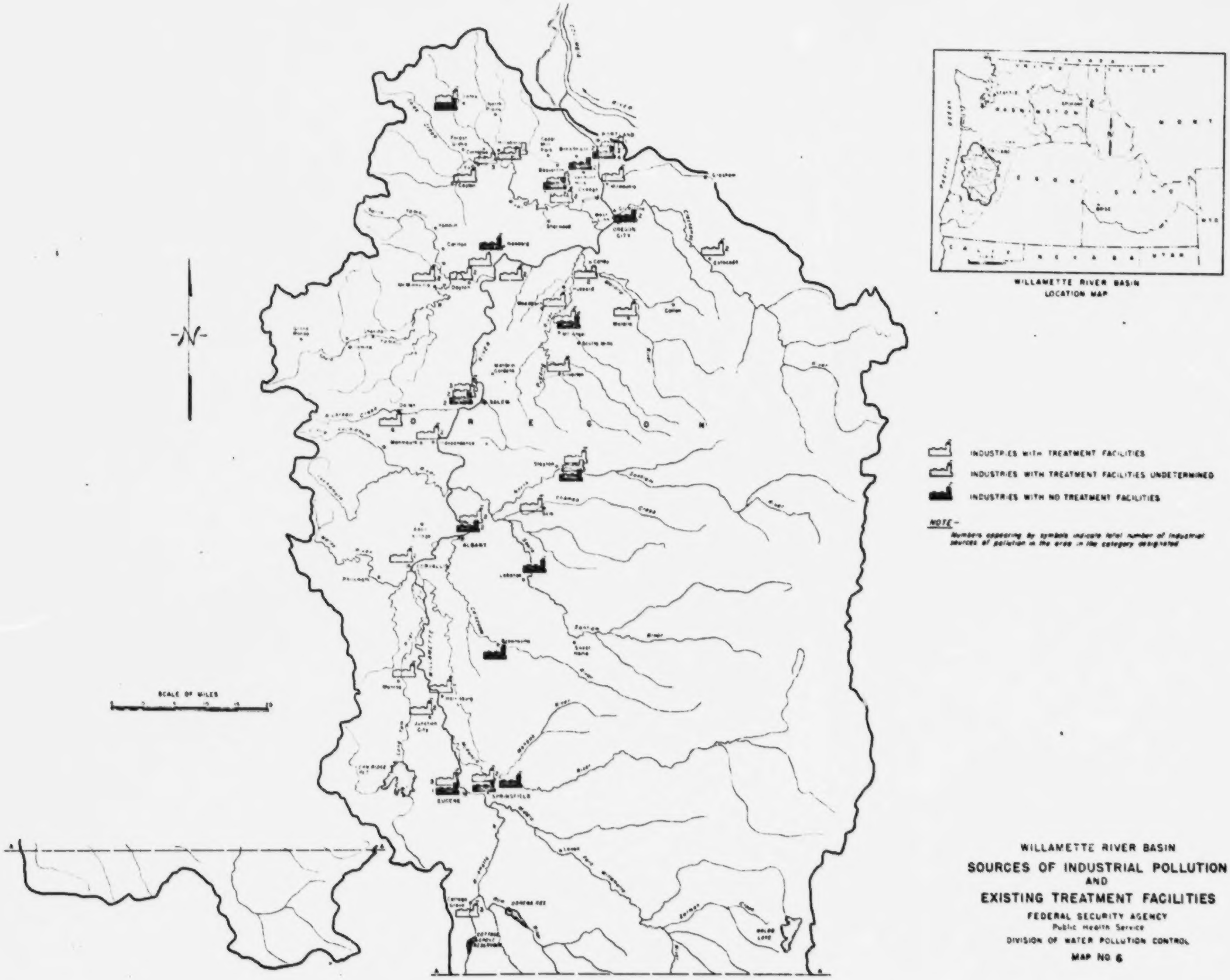
WILLAMETTE RIVER BASIN

SOURCES OF MUNICIPAL POLLUTION
AND
EXISTING TREATMENT FACILITIES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP No. 5

B


INDUSTRIES WITH TREATMENT FACILITIES
INDUSTRIES WITH TREATMENT FACILITIES UNDETERMINED
INDUSTRIES WITH NO TREATMENT FACILITIES
NOTE -
Numbers appearing by symbols indicate total number of industrial sources of pollution in the area in the category designated
WILLAMETTE RIVER BASIN
LOCATION MAP
SCALE OF MILES
0
5
10
15
20
N
O R E G O N
PORTLAND
OREGON CITY
SALEM
ALBANY
EUGENE
SPRINGFIELD
Gresham
Estacada
Newberg
Dayton
Carlton
Sherwood
Stayton
Lebanon
Junction City
Harrisburg
Cottage Grove
Columbia River

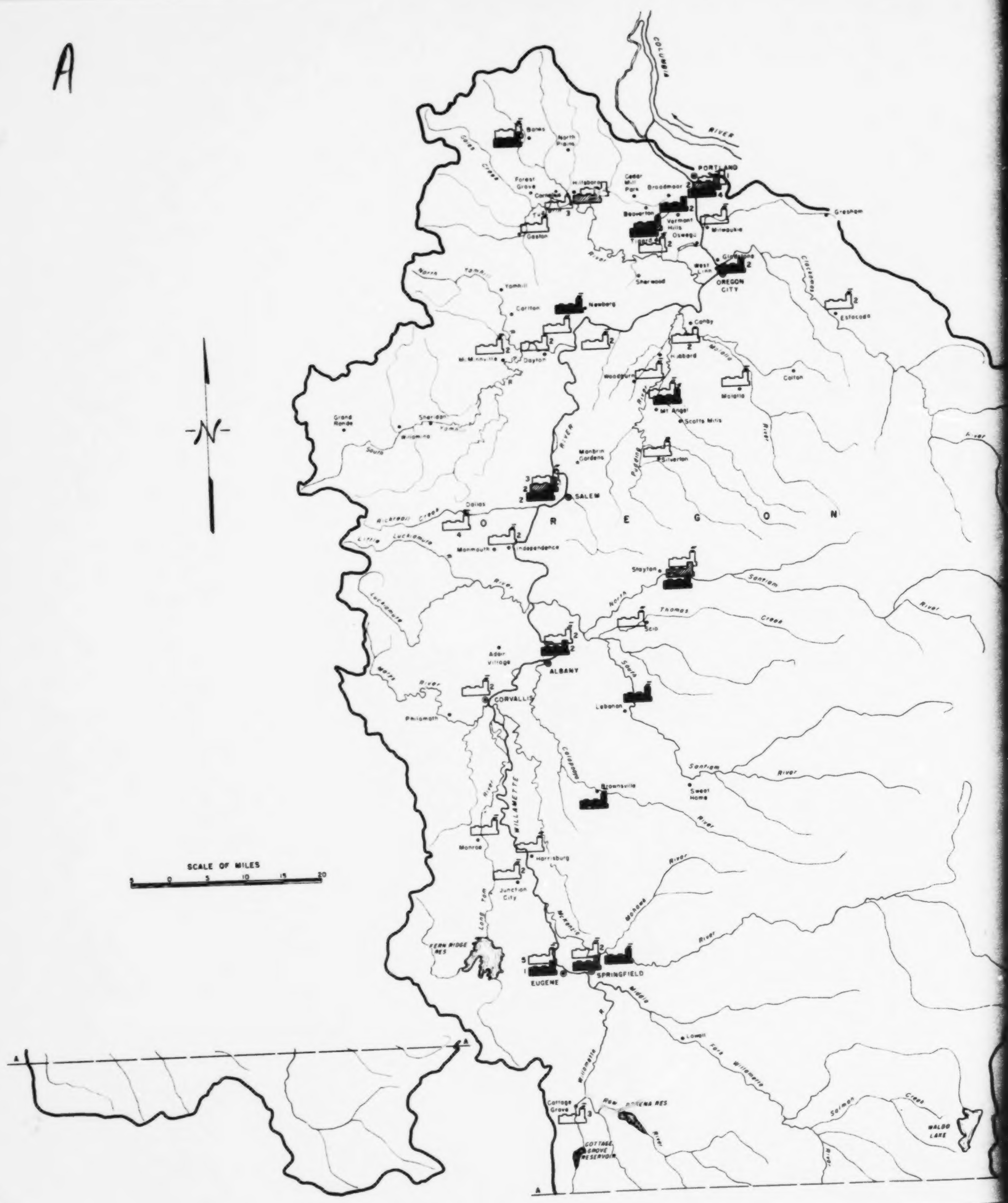
WILLAMETTE RIVER BASIN

SOURCES OF INDUSTRIAL POLLUTION
AND
EXISTING TREATMENT FACILITIES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO 6

A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Hillsboro
Cedar Mill Park
Broadmoor
Beaverton
Vermont Hills
Oswego
Tigard
Milwaukie
Gresham
Gaston
Gales Creek
River
Sherwood
West Linn
Gladstone
OREGON CITY
Clackamas
Estacada
North Yamhill
Yamhill
Carlton
Newberg
Canby
Hubbard
Molalla
Colton
McMinnville
Dayton
Woodburn
Mt Angel
Scotts Mills
Grand Ronde
Sheridan
Willamina
South Yamhill
RIVER
Manbrin Gardens
Pudding River
Silverton
SALEM
Dallas
Rickreall Creek
Little Luckiamute
O R E G O N
Monmouth
Independence
Stayton
North Santiam
River
Luckiamute
Thomas Creek
Scio
Adair Village
ALBANY
Marys River
CORVALLIS
Philomath
South
Lebanon
Calapooia
Santiam River
Sweet Home
Brownsville
River
WILLAMETTE
Monroe
Harrisburg
Junction City
Long Tom
McKenzie
Mohawk
River
FERN RIDGE RES
EUGENE
SPRINGFIELD
Middle Fork Willamette
Lowell
Salmon Creek
WALDO LAKE
Cottage Grove
Row River
DORENA RES
COTTAGE GROVE RESERVOIR
SCALE OF MILES
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15
20
N
A
A
A
1
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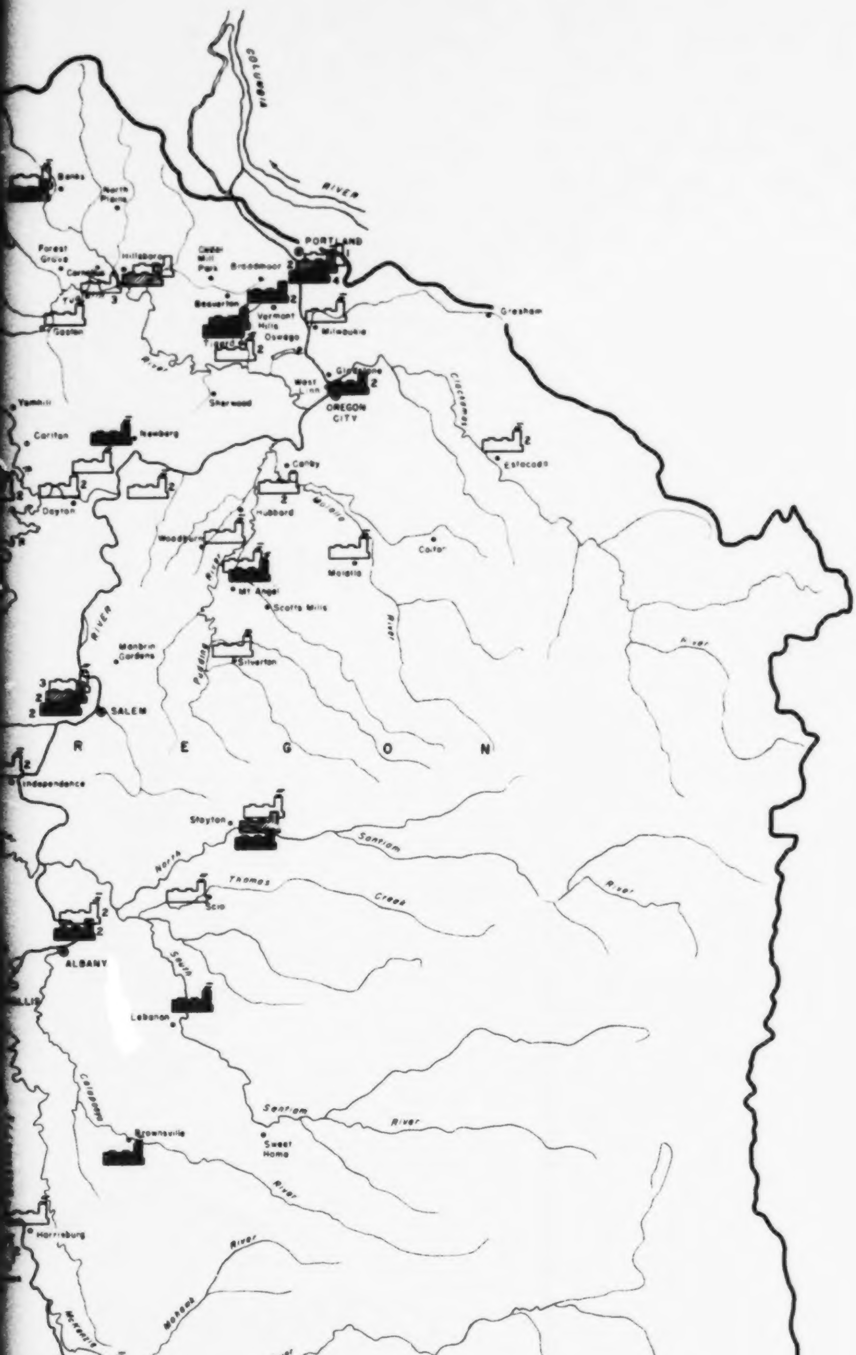
4
5

B


COLUMBIA
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Forest Grove
Cornelius
Hillsboro
Cedar Mill Park
Broadmoor
PORTLAND
Beaverton
Vermont Hills
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Tigard
Milwaukie
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Gladstone
OREGON CITY
Clackamas
Yamhill
Carlton
Newberg
Estacada
Canby
Dayton
Hubbard
Molalla
Woodburn
Molalla
Colton
Mt Angel
Scotts Mills
River
RIVER
River
Manbrin Gardens
Pudding
Silverton
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Lebanon
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Sweet Home
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Harrisburg
River
McKenzie
Mohawk
River
EUGENE
SPRINGFIELD
Middle
Lowell
Fork
Willamette
Willamette
Cottage Grove
Row
DORENA RES
River
COTTAGE GROVE RESERVOIR
Salmon
Creek
WALDO LAKE
River
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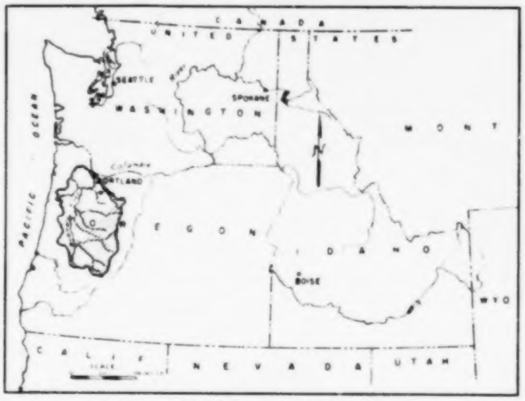
1
3


CANADA
UNITED STATES
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SPOKANE
WASHINGTON
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PACIFIC OCEAN
PORTLAND
OREGON
IDAHO
BOISE
WYO
CALIF
NEVADA
UTAH
N

WILLAMETTE RIVER BASIN
LOCATION MAP

□ INDUSTRIES WITH TREATMENT FACILITIES

▨ INDUSTRIES WITH TREATMENT FACILITIES UNDETERMINED

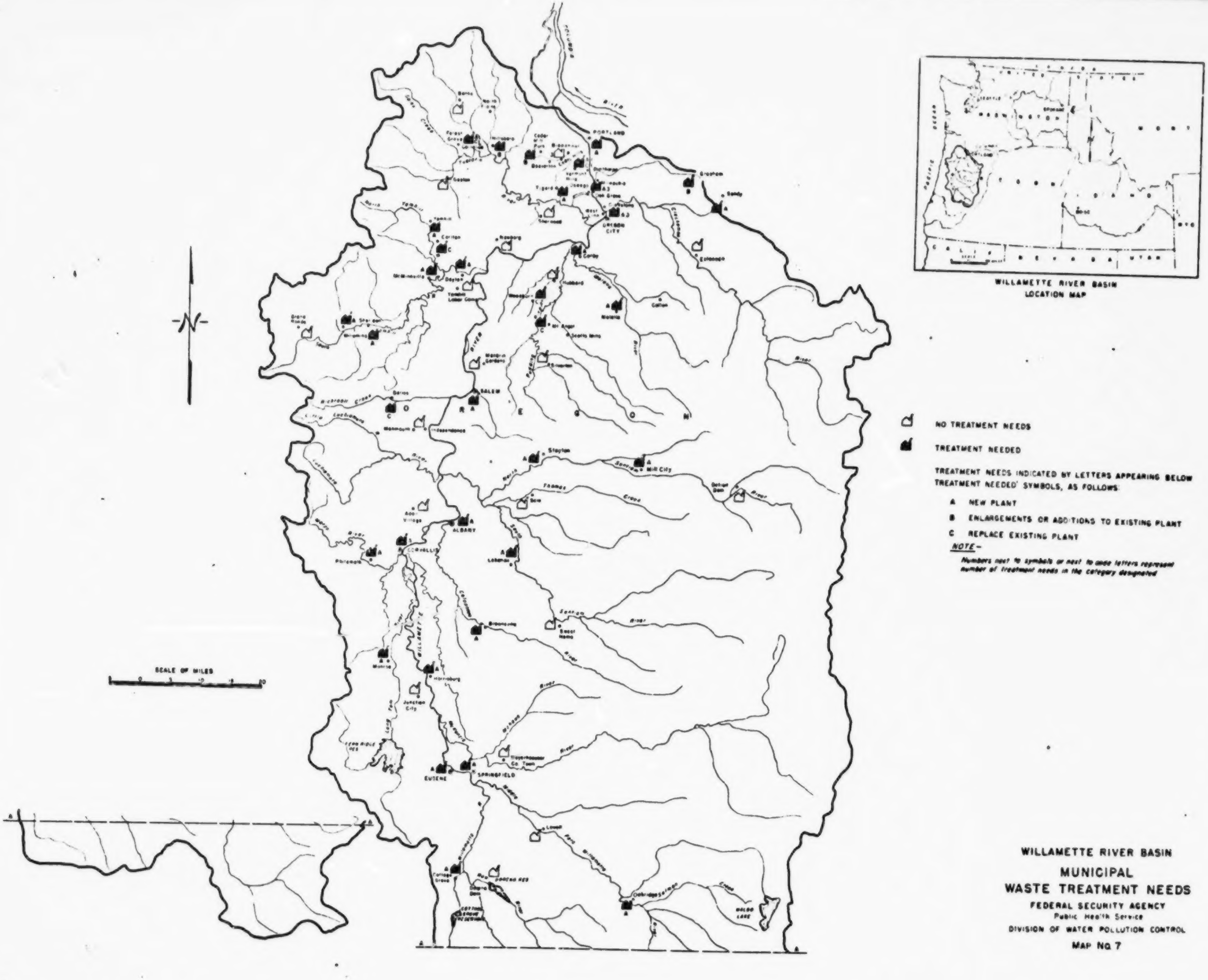
■ INDUSTRIES WITH NO TREATMENT FACILITIES

NOTE –
Numbers appearing by symbols indicate total number of Industrial sources of pollution in the area in the category designated

WILLAMETTE RIVER BASIN
SOURCES OF INDUSTRIAL POLLUTION
AND
EXISTING TREATMENT FACILITIES

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

MAP NO. 6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Forest Grove
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Tigard
Sherwood
Gaston
Yamhill
Carlton
McMinnville
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Sheridan
Willamina
Grand Ronde
Milwaukie
Oswego
Lake Grove
West Linn
Gladstone
OREGON CITY
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Estacada
Hubbard
Woodburn
Mt. Angel
Scotts Mills
Molalla
Colton
Silverton
SALEM
Dallas
Monmouth
Independence
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Stayton
Mill City
Detroit Dam
Scio
Adair Village
ALBANY
CORVALLIS
Philomath
Lebanon
Brownsville
Sweet Home
Monroe
Harrisburg
Junction City
WILLAMETTE
Fern Ridge Res
EUGENE
SPRINGFIELD
Lowell
Cottage Grove
Oakridge
Waldo Lake
River
Creek
SCALE OF MILES
0
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20
N
A
B
C

WILLAMETTE RIVER BASIN
LOCATION MAP

☖ NO TREATMENT NEEDS

☗ TREATMENT NEEDED

TREATMENT NEEDS INDICATED BY LETTERS APPEARING BELOW "TREATMENT NEEDED" SYMBOLS, AS FOLLOWS:

A NEW PLANT

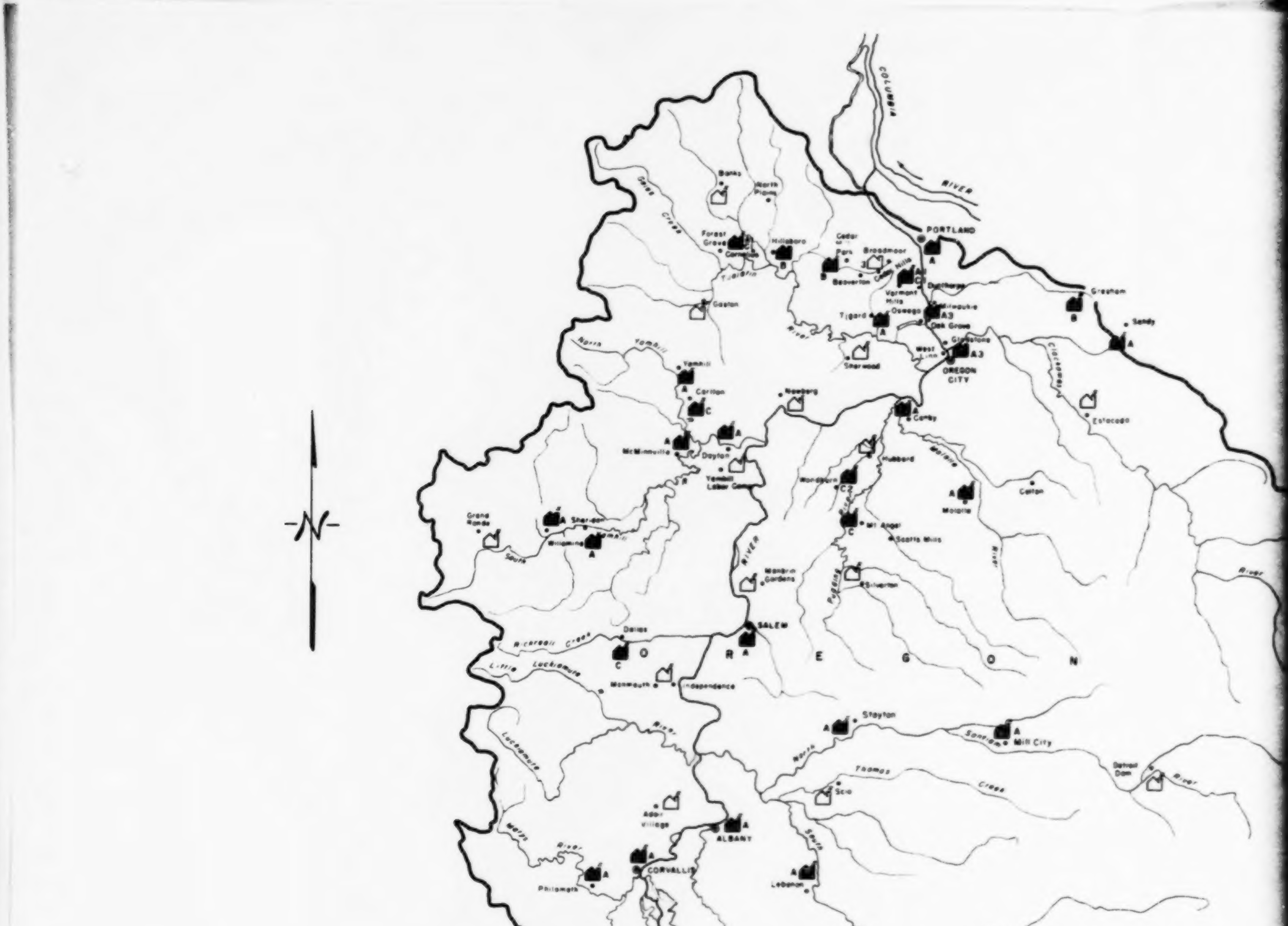
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT

C REPLACE EXISTING PLANT

NOTE–

Numbers next to symbols or next to code letters represent number of treatment needs in the category designated

WILLAMETTE RIVER BASIN
MUNICIPAL
WASTE TREATMENT NEEDS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 7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Cornelius
Hillsboro
Cedar Hills
Park
Broadmoor
Beaverton
Vermont Hills
Dunthorpe
Milwaukie
Oswego
Tigard
Oak Grove
Gladstone
West Linn
OREGON CITY
Gresham
Sandy
Gaston
Sherwood
Tualatin River
Gales Creek
North Yamhill
Yamhill
Carlton
Newberg
McMinnville
Dayton
Yamhill Labor Camp
Canby
Hubbard
Woodburn
Mt Angel
Scotts Mills
Molalla
Colton
Estacada
Clackamas
Grand Ronde
Sheridan
Willamina
Yamhill
Silverton
Waconda Gardens
SALEM
Dallas
Rickreall Creek
Little Luckiamute
Monmouth
Independence
O R E G O N
Stayton
Mill City
North Santiam
Detroit Dam
Thomas Creek
Scio
Luckiamute River
Adair Village
ALBANY
Marys River
Philomath
CORVALLIS
Lebanon
Calapooia
Brownsville
Santiam River
Sweet Home
South Santiam River
WILLAMETTE
Long Tom River
Monroe
Harrisburg
Junction City
Mohawk River
FERN RIDGE RES
Weyerhaeuser Co. Town
McKenzie River
EUGENE
SPRINGFIELD
Middle Fork Willamette
Fall Creek
Coast Fork Willamette
Cottage Grove
Row River
DORENA RES
Dorena Dam
COTTAGE GROVE RESERVOIR
Oakridge
Salmon Creek
WALDO LAKE
A
A
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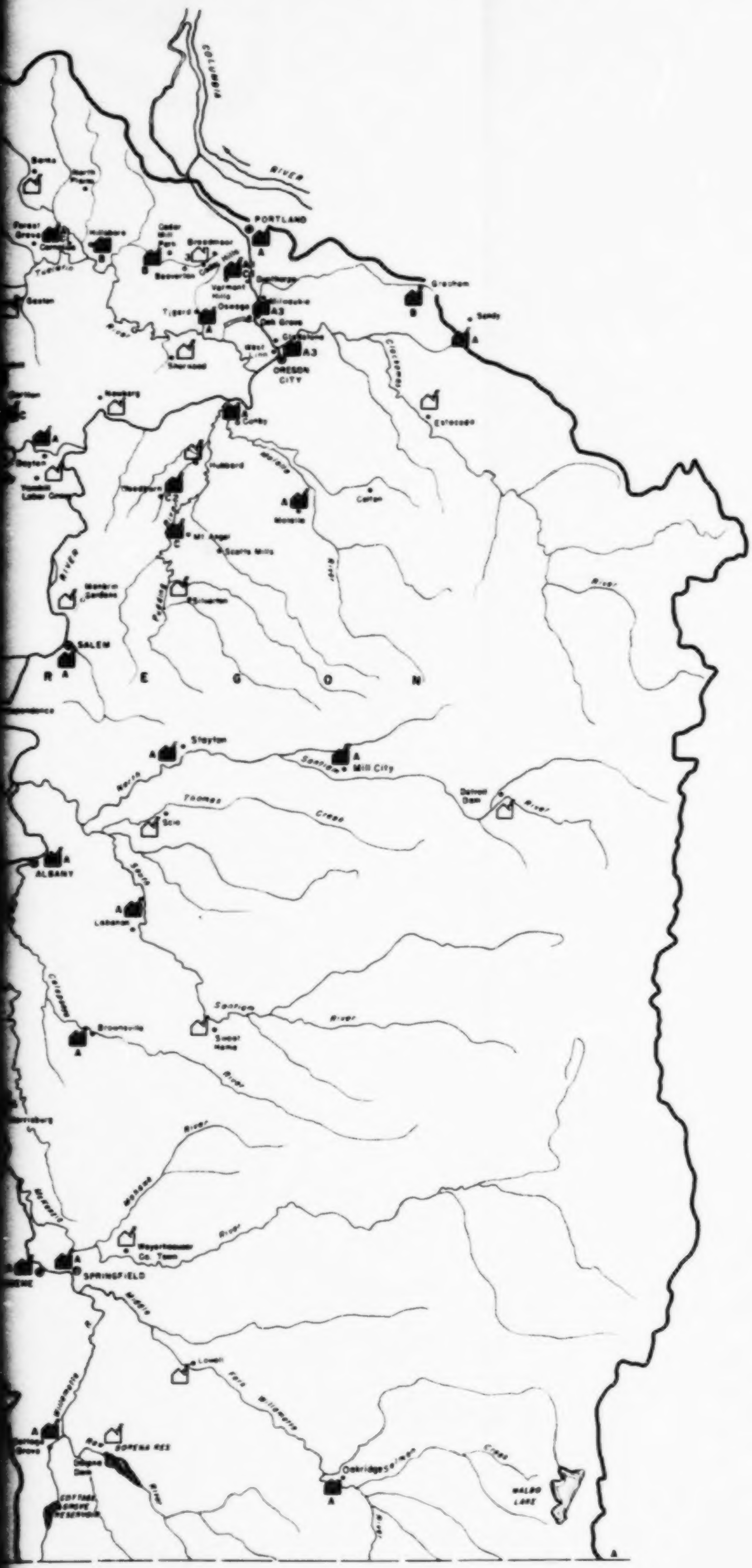
A
N
SCALE OF MILES
5 0 5 10 15 20

A


COLUMBIA
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North Plains
Forest Grove
Cornelius
Hillsboro
Cedar Mill Park
Broadmoor
Beaverton
Vermont Hills
Tualatin
Gaston
Tigard
Oswego
Milwaukie
Oak Grove
Gresham
Sandy
West Linn
OREGON CITY
Sherwood
Newberg
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Estacada
Clackamas
Dayton
Hubbard
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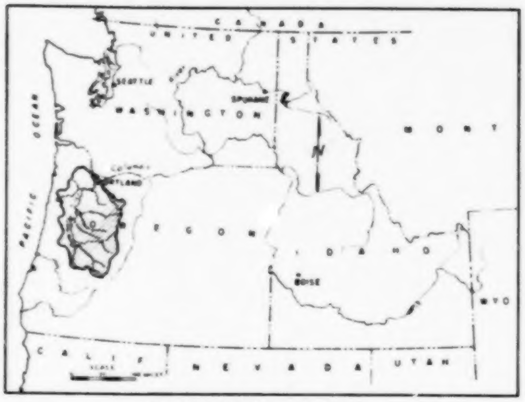
Molalla
Colton
Mt Angel
Scotts Mills
Silverton
Pudding
SALEM
O R E G O N
Independence
Stayton
Mill City
Santiam
North
Thomas
Creek
Detroit Dam
Scio
ALBANY
Lebanon
Calapooya
Brownsville
Sweet Home
Santiam
River
Harrisburg
Mohawk
River
Weyerhaeuser Co. Town
SPRINGFIELD
Middle
Lowell
Fork
Willamette
Cottage Grove
Dorena Dam
DORENA RES
COTTAGE GROVE RESERVOIR
Oakridge
Salmon
Creek
WALDO LAKE
A
B
C
A3


CANADA
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SEATTLE
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WASHINGTON
PACIFIC
OCEAN
Columbia
PORTLAND
OREGON
IDAHO
BOISE
MONT
WYO
CALIF
NEVADA
UTAH
SCALE

WILLAMETTE RIVER BASIN
LOCATION MAP

☖	NO TREATMENT NEEDS
☗	TREATMENT NEEDED

TREATMENT NEEDS INDICATED BY LETTERS APPEARING BELOW TREATMENT NEEDED' SYMBOLS, AS FOLLOWS:

A	NEW PLANT
B	ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C	REPLACE EXISTING PLANT

NOTE –

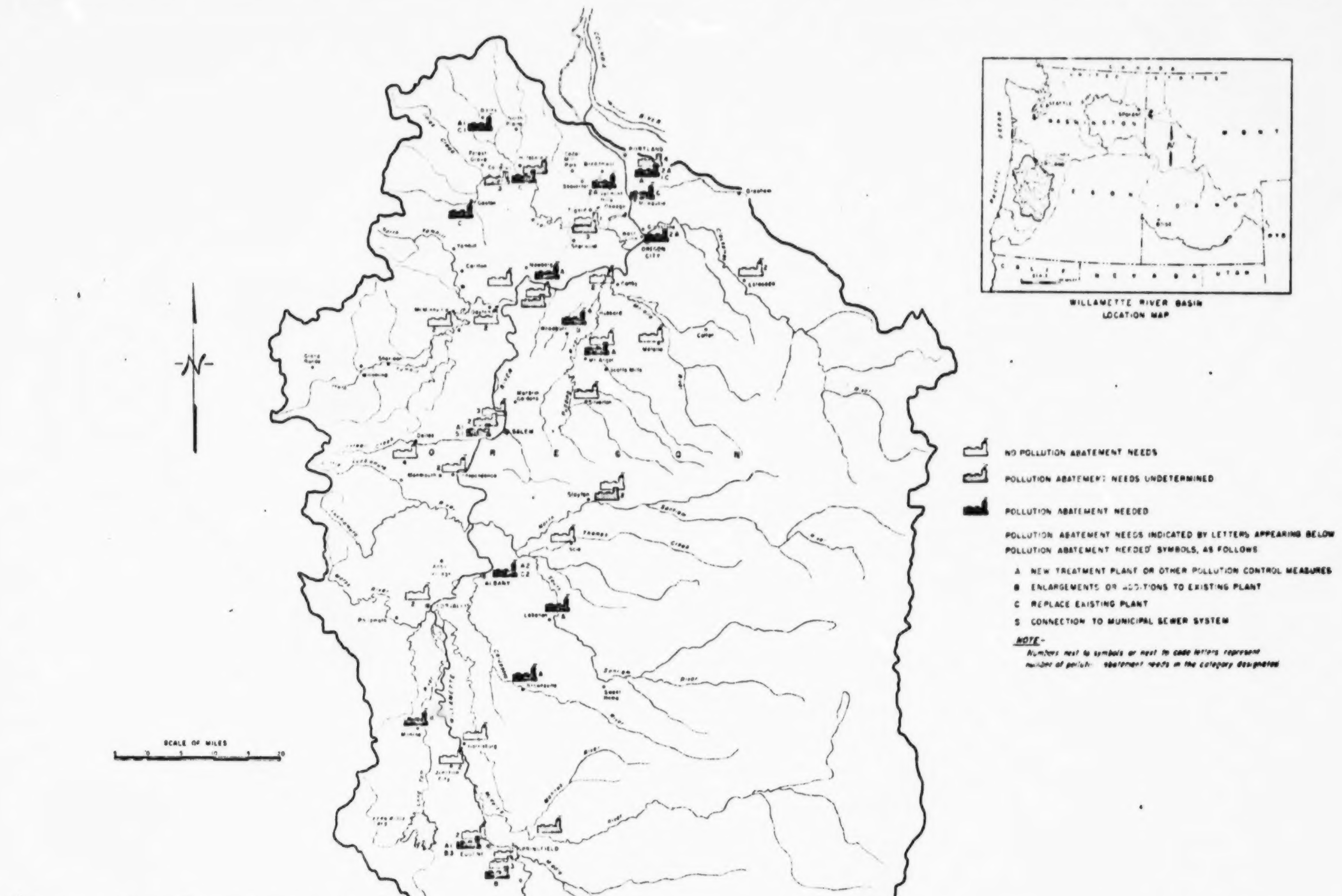
Numbers next to symbols or next to code letters represent number of treatment needs in the category designated

WILLAMETTE RIVER BASIN
MUNICIPAL
WASTE TREATMENT NEEDS

FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL

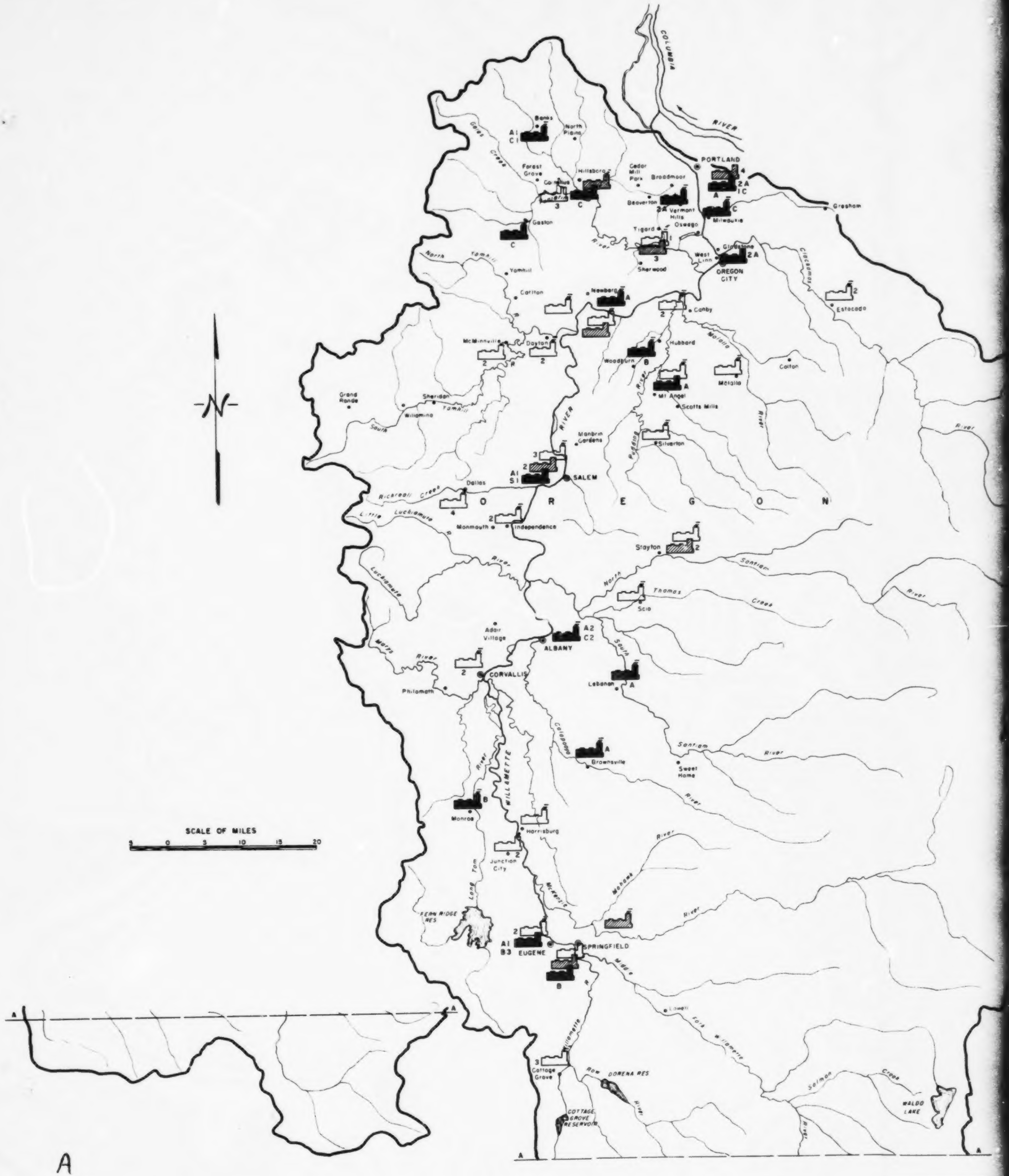
MAP NO. 7

13



WILLAMETTE RIVER BASIN
LOCATION MAP
OREGON
WASHINGTON
IDAHO
NEVADA
UTAH
Boise
Spokane
O R E G O N
COLUMBIA RIVER
PORTLAND
Gresham
Milwaukie
OREGON CITY
Estacada
Forest Grove
Hillsboro
Beaverton
Tigard
Sherwood
Gaston
Yamhill
Carlton
Newberg
Canby
Hubbard
Woodburn
Mt. Angel
Scotts Mills
Molalla
Colton
McMinnville
Dayton
Sheridan
Willamina
Grand Ronde
Marion Gardens
Silverton
SALEM
Dallas
Monmouth
Independence
Stayton
Scio
ALBANY
Lebanon
CORVALLIS
Philomath
Brownsville
Sweet Home
Harrisburg
Junction City
EUGENE
SPRINGFIELD
Cottage Grove
Waldo Lake
Santiam River
Thomas Creek
McKenzie River
Coast Fork Willamette
Middle Fork Willamette
SCALE OF MILES
0 5 10 15 20
N
A1 C1
A2 C2
A1 S1
A1 B3
NO POLLUTION ABATEMENT NEEDS
POLLUTION ABATEMENT NEEDS UNDETERMINED
POLLUTION ABATEMENT NEEDED
POLLUTION ABATEMENT NEEDS INDICATED BY LETTERS APPEARING BELOW POLLUTION ABATEMENT NEEDED SYMBOLS, AS FOLLOWS
A NEW TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C REPLACE EXISTING PLANT
S CONNECTION TO MUNICIPAL SEWER SYSTEM
NOTE-
Numbers next to symbols or next to code letters represent number of pollution abatement needs in the category designated

WILLAMETTE RIVER BASIN
INDUSTRIAL
POLLUTION ABATEMENT NEEDS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO 8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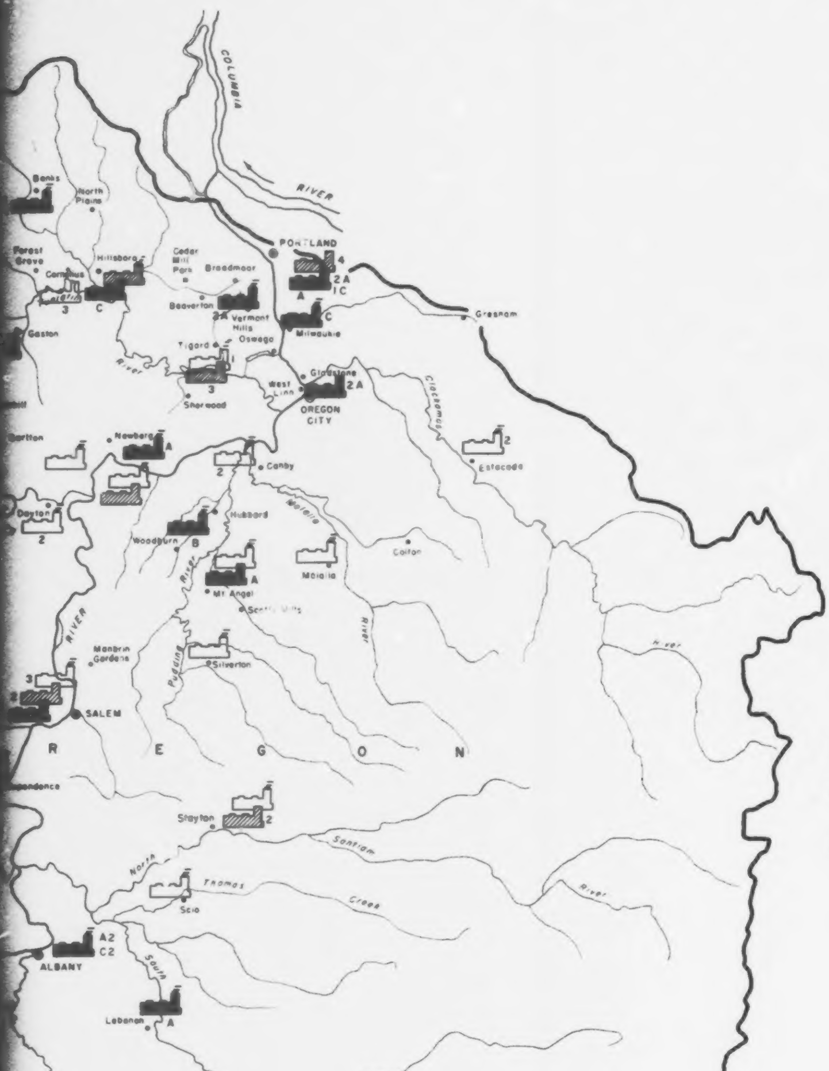
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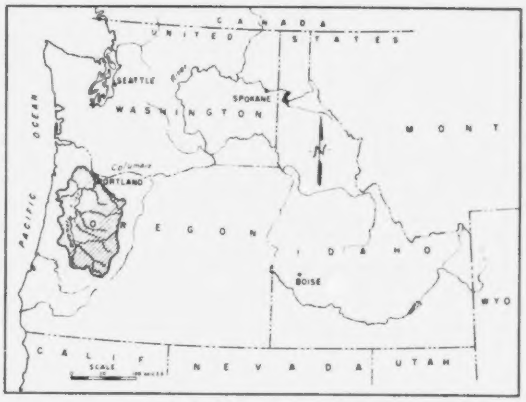
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Columbia
PORTLAND
R E G O N
I D A H O
BOISE
WYO
C A L I F
N E V A D A
U T A H
SCALE

WILLAMETTE RIVER BASIN
LOCATION MAP

NO POLLUTION ABATEMENT NEEDS

▨ POLLUTION ABATEMENT NEEDS UNDETERMINED

■ POLLUTION ABATEMENT NEEDED

POLLUTION ABATEMENT NEEDS INDICATED BY LETTERS APPEARING BELOW POLLUTION ABATEMENT NEEDED SYMBOLS, AS FOLLOWS:

A NEW TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES
B ENLARGEMENTS OR ADDITIONS TO EXISTING PLANT
C REPLACE EXISTING PLANT
S CONNECTION TO MUNICIPAL SEWER SYSTEM

NOTE -
Numbers next to symbols or next to code letters represent number of pollution abatement needs in the category designated

WILLAMETTE RIVER BASIN
INDUSTRIAL
POLLUTION ABATEMENT NEEDS
FEDERAL SECURITY AGENCY
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP No. 8

B

APPENDIX -- 9

SPECIAL STUDIES AND TABLES

APPENDIX 9 -- SECTION 1

SUMMARY OF OREGON STATE WATER POLLUTION CONTROL LEGISLATION

General Statement

Secs., 116-1118 to 116-1129, O.C.L.A., set up a Sanitary Authority and declare it to be the policy of the State to preserve the natural purity of its waters. The Water Code contains numerous provisions stating that the placing of polluting, deleterious, or other offensive substances in or near streams, etc., constitutes a misdemeanor. (116-1101 to 116-1112). Cities and towns are given jurisdiction over property owned and occupied for waterworks, reservoirs, etc., and the maintenance of any plant or industry which pollutes such water supply is declared to be a nuisance, maintenance of which may be enjoined on petition of city or appropriate official thereof. (116-1113 to 116-1117). Particular areas in the State are subject to particular provisions as to use of property adjacent to watercourses. (116-1130 to 116-1143). Chapter 378, Laws of 1949, authorizes the formation of local sanitary districts.

Administrative Organization

The Sanitary Authority is established as a division of the State Board of Health; it is composed of three members appointed by the Governor; and of the State Health Officer, the State

Engineer, and the Chairman of the State Fish Commission, who serve ex-officio (116-1120 and 116-1121). The State Sanitary Engineer, who is employed by the State Board of Health, serves as secretary and chief engineer of the State Sanitary Authority (116-1123).

The Sanitary Authority is authorized to encourage voluntary cooperation of individuals, corporations, etc., in preserving the purity of the waters of the State; to formulate rules and regulations pertaining to control of pollution; to establish standards of purity for waters in the State; to conduct studies, prepare programs, etc., individually and in cooperation with others, all to the end of reducing pollution of waters, to receive complaints as to pollution and to investigate and take action thereon; to conduct public hearings in regard to any municipality, etc., whose sewage or waste disposal is brought to the attention of the Sanitary Authority; to enforce compliance with the laws of the State concerning the pollution of waters (116-1122), and to examine and pass on all plans and specifications for new and altered sewer systems or sewage or waste treatment works (116-1124).

Powers and Duties

(1) Sec. 116-1122(c) specifically authorizes the Sanitary Authority to conduct studies independently or in cooperation with others, and to prepare a program or programs relating to the purity of waters of the State or to the treatment and

disposal of sewage and other wastes. Sec. 116-1125 authorizes the Sanitary Authority to represent Oregon in interstate plans and programs for the control of water pollution. Sec. 116-1122(b) authorizes the Sanitary Authority to establish standards of purity of the various waters of the State. Pursuant to this authorization, Regulation 1 has been adopted establishing standards of purity which serve as a guide for determining the degree of sewage or waste treatment required in specific cases.

(2) Issuance of permits, etc. -- all plans and specifications for the construction of new sewer systems, sewage treatment plants, waste treatment or reduction plants, either in connection with existing municipal sewers, industrial waste sewers or treatment or reduction plants established at the time this Act was approved, or in connection with sewers or plants built after the passage of the Act, or major modifications of or additions to existing systems or plants, must be submitted to the Sanitary Authority and approved by it before construction is begun (116-1124). No specific mention is made of new sources of pollution.

(3) Enforcement -- The Sanitary Authority is authorized by Sec. 116-1122(d), (e), and (f) to receive complaints, petitions, or remonstrances from individual citizens, groups of citizens, organizations, etc., relative to any condition or situation which is alleged to involve the pollution of the waters of the State, and to investigate and take action thereon; to hold

public hearings and publish findings and recommendations as the result of such hearings; and to take appropriate action for the enforcement of the rules, regulations, and orders issued as the result of such hearings, and to enforce compliance with the State law in regard to water pollution. Under Sec. 116-1126 the State of Oregon on relation of the Sanitary Authority, the Attorney General, or the District or City Attorney of a county or city affected by the pollution, may sue in law or equity to abate an alleged public nuisance created by pollution of the waters of the State.

Sec. 116-1128 gives to any person, corporation, etc., which deems itself aggrieved by any order of the Sanitary Authority, the right to appeal from such order to the Circuit Court of the county in which the affected property is situated. The statute provides for a summary hearing, to be determined as a suit in equity, at which the aggrieved person and the Authority may present evidence and are entitled to compulsory attendance of witnesses and the production of books and papers; the order of the Sanitary Authority is suspended during such appeal (116-1128).

(4) Conduct of studies, investigations and research -- The State Sanitary Authority is empowered to conduct studies, make investigations and perform research relating to the purity of the waters of the State of Oregon or the treatment and disposal of sewage or other wastes. (116-1122(c)).

Under Sec. 116-1123 the Sanitary Authority is empowered to cooperate with the United States and with other departments of the State of Oregon and with industry in the study and control of municipal sewage or industrial waste treatment or water pollution.

(5) Cooperation with other public and private agencies -- The Sanitary Authority may cooperate with and receive funds from the Federal Government and from other State departments for the study and control of municipal sewage or industrial waste treatment or water pollution (116-1123). Under Sec. 116-1125 the Sanitary Authority is empowered to represent the State of Oregon in any proceedings and matters pertaining to plans, procedure and/or interstate compacts in relation to control of pollution of waters of Oregon and adjacent States.

(6) Administrative powers -- The Sanitary Authority can hold hearings and summon witnesses. (116-1122(c)). The Authority has investigatory powers and has general authority to enforce compliance with the laws of the State concerning water pollution and can issue orders after public hearing (116-1122(e) and (f)). There is no permit procedure established except that approval of plans and specifications is required before construction of new or enlarged sewer or treatment plants can be undertaken (116-1124). Rules and regulations may be adopted by the Authority (116-1122(e)).

Exemptions from Operation of Act

There is no specific exemption from the operation of this Act, but Sec. 116-1127 recognizes that hardship may result from an order of the Sanitary Authority, and this section, therefore, authorizes the Sanitary Authority in cases of undue hardship to delay enforcement of the order upon the entry of written stipulation of the concerned parties.

Preservation of existing rights and remedies

No specific statutory provision.

Statement of Policy, etc.

Secs. 116-1118 and 116-1119 state the public policy of the State to preserve the purity of the waters in the interest of public welfare, for the protection of public health, recreation, etc.

Sec. 116-1129 provides that in case this statute is in conflict with any other statutes this statute shall prevail. The statute contains no severability clause.

Interstate Agencies

Although the Sanitary Authority is authorized to represent the State of Oregon in interstate compacts by Sec. 116-1125, it has not as yet entered into any such interstate agreements.

APPENDIX 9 -- SECTION 2

CITY OF PORTLAND -- WATERWORKS

Description

Portland obtains its water from the Bull Run River, a tributary to the Sandy River which empties into the Columbia River. Water flows by gravity from the headworks through three steel pipe lines, approximately 25 miles to the city. The supply watershed lies in the uninhabited Bull Run Forest Reserve and the major source of the river is Bull Run Lake. The water supply is very soft and free from human contamination.

Area Supplied

The Portland Waterworks supplies the entire city of Portland and furnishes water for 63 water companies and water districts which are located in the counties of Multnomah, Clackamas, and Washington.

Water Requirements

Water is supplied directly to 102,000 domestic consumers, 845 industries, and 63 water companies and water districts. Population served in the city and directly outside of the city is 379,000, and the population served through water companies and water districts is 99,000. Present water demands are listed below:

(a)	Average daily	56.37 m.g.d.
(b)	Maximum daily	138.00 m.g.d.

(c) Maximum hourly . . . . 248.00 m.g.d.

(d) Average daily (Peak month--July) .. 104.20 m.g.d.

Water Rates

Within the city monthly meter rates are: 11¢ per 100 cu. ft. for first 20,000 cu. ft.; 8¢ per 100 cu. ft. for next 100,000 cu. ft.; and 5¢ per 100 cu. ft. for all over 120,000 cu. ft. Monthly rates outside the city vary from 8¢ to 15¢ per 100 cu. ft. for gravity flow to about three times city rates for pumped water.

Water Quality and Treatment

The following is a chemical analysis of a tap sample of Portland city water, taken on September 19, 1947.

	Parts per Million	Grains per Gallon
Color	15	
Turbidity less than	1	
Total solids (Residue on Evaporation	30.4	1.78
Volatile solids (Loss on Ignition)	6.4	0.37
Fixed Solids (Residue after Ignition)	24.0	1.41
Alkalinity (as $CaCO_3$)		
Carbonate	0.0	0.00
Bicarbonate	12.5	0.73
Hardness (as $CaCO_3$)	8.8	0.52
Silica (SiO_2)	7.2	0.42

	Parts per Million	Grains per Gallon
Calcium (Ca)	2.3	0.13
Magnesium (Mg)	0.7	0.04
Sodium (Na)	2.1	0.12
Potassium (K)	0.2	0.01
Iron (Fe)	0.2	0.01
Aluminum (Al)	0.7	0.04
Manganese (Mn)	0.00	0.000
Bicarbonate (HCO_3)	15.2	0.89
Chloride (Cl)	2.4	0.14
Sulfate (SO_4)	0.9	0.05
Nitrate (NO_3)	0.3	0.02
Phosphate (PO_4)	trace	trace
Fluoride (F)	0.0	0.00
Ammonia (NH_4)	0.7	0.04
Dissolved Oxygen (O_2)	9.9	0.58
Free Carbon Dioxide (CO_2)	0.7	0.04
Free Chlorine (Cl)	0.10	0.006
pH Value (Reaction) 7.0		

The Portland City Water Engineer states that there is very little difference between the chemical content of raw and tap water. The only treatment is the addition of chlorine and ammonia at the headworks. A residual of 0.1 p.p.m. chlorine is maintained in the city reservoirs. The treatment equipment consists of three Wallace and Tiernan Chlorinators, type MSV, each with a capacity of 300 lbs. per 24 hours and two Ammoniators, each with a capacity of 200 lbs. per 24 hours.

Supply Facilities

Bull Run River, which has an average flow of 500 m.g.d. at the point of diversion, has as its main source Bull Run Lake, which has a storage capacity of three billion gallons. The watershed area is 102 sq. miles. The Bull Run Storage Project, five miles above the headworks, provides 11 billion gallons storage capacity. Although the safe yield is 200 m.g.d. with present storage facilities, it could be developed to 350 m.g.d. by the creation of additional storage facilities. Pipe lines with a total capacity of 150 m.g.d. transmit the water to the city and are listed as follows:

No. 1 -- 42", 35", 33" riveted -- Length 24.3 mi.
Capacity 25 m.g.d.

No. 2 -- 52", 44" Lock Bar -- Length 24.76 mi.
Capacity 50 m.g.d.

No. 3 -- 58", 50" Lock Bar -- Length 25.10 mi.
Capacity 75 m.g.d.

Distribution Facilities

The distribution system contains 6 large open reservoirs and many smaller elevated tanks and standpipes. In general the mains are not less than 8" in residential and 12" in business areas. However, as an exception to this, two inch lines are installed in the development of new areas, since city law does not permit the installation of permanent mains until yearly revenue from the area equals 6 percent of the cost of permanent mains. Most of the city is supplied by gravity flow and only about 10 percent of the total water used is pumped. During the summer, restrictions are necessary on residential lawn sprinkling and garden irrigation. The six main distribution storage reservoirs, which are listed below, are the open ground type.

Res. No. 1. Mt. Tabor, Cap.	12.0 m.g.
Res. No. 2. Mt. Tabor, Cap.	20.5 m.g.
Res. No. 3. City Park, Cap.	16.4 m.g.
Res. No. 4. City Park, Cap.	17.6 m.g.
Res. No. 5. Mt. Tabor, Cap.	49.0 m.g.
Res. No. 6. Mt. Tabor, Cap.	75.0 m.g.
TOTAL CAPACITY	190.5 m.g.

The six standpipes are as follows:

Burlingame Standpipe No. 1, Cap.	114,800 Gal.
Burlingame Standpipe No. 2, Cap.	380,000 Gal.
Council Crest Standpipe No. 1, Cap. . . .	60,000 Gal.
Council Crest Standpipe No. 2, Cap. . . .	500,000 Gal.
St. Johns Standpipe, Cap.	360,000 Gal.
Marquam Hill Standpipe, Cap.	287,000 Gal.
TOTAL CAPACITY. . .	1,701,800 Gal.

There are 25 other tanks, listed as follows:

1.	Vernon Tank, Cap.	1.000 m.g.
2.	St. Johns Tank, Cap.	1.000 m.g.
3.	Kings Heights, Cap.	0.200 m.g.
4.	Mt. Tabor, Cap.	0.200 m.g.
5.	Portland Heights, Cap.	0.600 m.g.
6.	Portland Heights No. 2, Cap.	0.500 m.g.
7.	Willamette Heights, Cap.	0.060 m.g.
8.	South Portland, Cap.	0.060 m.g.
9.	Upper Linnton, Cap.	0.130 m.g.
10.	Lower Linnton, Cap.	0.130 m.g.
11.	Upper Whitwood, Cap.	0.130 m.g.
12.	Lower Whitwood, Cap.	0.065 m.g.
13.	Upper Willbridge, Cap. (Not in use)	0.065 m.g.
14.	Lower Willbridge, Cap.	0.130 m.g.
15.	Willalatin Park, Cap. (Not in use)	0.130 m.g.
16.	Sellwood Tank, Cap.	0.500 m.g.
17.	Bertha District, Cap.	0.200 m.g.
18.	Bertha District, Cap.	0.050 m.g.
19.	Arlington Heights, Cap.	0.500 m.g.
20.	SW Texas St. and 31st Ave., Cap.	0.615 m.g.
21.	SW Nevada St. and 31st Ave., Cap.	0.615 m.g.
22.	SW Nevada St. and 32nd Ave., Cap.	0.200 m.g.
23.	SW Nevada and 27th Ave., Cap.	0.617 m.g.
24.	SW Canby St. and 19th Ave., Cap.	0.350 m.g.
25.	SW Canby St. and 19th Ave., Cap.	0.100 m.g.
	TOTAL CAPACITY	8.147 m.g.
	GRAND TOTAL CAPACITY	200.35 m.g.

Construction Underway

The major project is the installation of a 20" steel main, 11,000 feet long at a cost of $125,000 for improvement of the distribution system.

Construction Planned

Improvements of the distribution system planned for the fiscal year, 1951-52, are as follows: (1) Installation of 1,560 tons of cast iron pipe and fittings at a material cost of $180,000 for miscellaneous projects; (2) installation of a 380,000 gallon steel tank at a material cost of $35,000; and (3) laying a 20" pipe line at a material cost of $135,000. A new 100 m.g.d. conduit is planned for construction in the near future. It is estimated that this supply conduit, which will extend from the headworks to the city, will consist of 10 miles of 66" steel pipe and 15 miles of 56" steel pipe and will cost from 5 to 6 million dollars. This new conduit is planned mainly to increase the available supply as well as to provide for future inactivation of the old 25 m.g.d. pipeline.

APPENDIX 9 -- SECTION 3

CITY OF SALEM WATERWORKS

Description

The Salem City Water Department obtains its water supply from the North Santiam River at a point approximately 18 miles southeast of Salem. The river water, somewhat polluted with silt and human contamination, passes through the natural gravel of Staten Island to infiltration galleries located in the center of the Island. It then flows by gravity through a 36-inch diameter steel pipe to Salem's distribution system. Three pump-operated wells, each capable of delivering 2 m.g.d. to the gravity pipe line, are also located on the island. These wells produce a clearer water than the infiltration galleries when the river is carrying a high sediment load, and are then used to improve the quality of the water. The total capacity of the headworks system, while somewhat indefinite, has been estimated at 31 m.g.d.

The watershed of the North Santiam River above Staten Island contains an estimated population of approximately 5000 people. The lower areas are devoted to agriculture with some irrigation, but the bulk of the watershed is mountainous and forest-covered. Towns along the valley contain a population of 3,500, but there is no direct evidence of human pollution of the stream from this source. At present, Detroit Dam is under construction on the watershed and has contributed some fine rock dust to the stream which passed through the infiltration galleries to the Salem water supply. This situation is now being corrected by impounding the gravel wash water at the damsite. Recreational, agricultural, and commercial activities in the watershed area contribute some human pollution to the river in addition to the silt load.

Area Supplied

The Salem City Water Department supplies all the area inside Salem City Limits with the exception of the small Capitola district which is soon to be supplied by the city. The system also supplies 3 water districts to the south of the city, the Town of Turner located 9 miles southeast of the city along the main supply pipeline, and Fairview Home.

Water Requirements

Inside the city limits water is supplied directly to 11,685 consumers representing a population of 43,064 and approximately 200 industries. Outside the city, 3 water districts, the Town of Turner, and Fairview Home are supplied by the City Water Department. In all, 48,500 people are served through 12,730 services, all of which are metered. The following are the quantities of water used, during the year 1950, in the entire system:

(a)	Average daily	8.86 m.g.d.
(b)	Maximum Day	19.43 m.g.
(c)	Maximum Hour	26.00 m.g.
(d)	Average Day Maximum Month (August) .	15.739 m.g.

Water Rates

City Water Department rates to metered services are as follows:

	Inside City	Outside City
First 200 cu. ft.	40¢ 100 cu. ft.	50¢ 100 cu. ft.
Next 300 cu. ft.	25¢ " " "	31¢ " " "
Next 1,500 cu. ft.	15¢ " " "	19¢ " " "
Next 14,000 cu. ft.	12¢ " " "	15¢ " " "
Next 20,000 cu. ft.	7½¢ " " "	9¢ " " "
All over 36,000 cu. ft.	5¢ " " "	6¢ " " "

Irrigation water is supplied to domestic residential users, inside the city only, at the following rates:

First 200 cu. ft.	40¢ 100 cu. ft.
Next 300 cu. ft.	25¢ " " "
All over 500 cu. ft.	5¢ " " "

Water Quality and Treatment

The Salem water supply receives some moderately effective natural filtration at the headworks as it flows through the gravel beds of Staten Island to the infiltration galleries, but otherwise the only treatment is chlorination using the Chlorine Ammonia process.

The following are analyses of the city water, as delivered to the consumer:

Units	Parts per Million	Parts per Million
Date	October 28, 1948	January 1950
Silica (SiO_2)	15.0	18.0
Iron (Fe)	.06	.04
Calcium (Ca)	4.2	9.8
Magnesium (Mg)	1.4	4.7
Sodium (Na) & Potassium (K)	3.1	5.6
Chloride (Cl)	1.5	1.0
Sulfate (SO_4)	1.4	1.8
Carbonate (CO_3)	0.0	0.0
Bicarbonate (HCO_3)	29.0	35.0
Alkalinity ($CaCO_3$)	28.0	29.0
Hardness ($CaCO_3$)	16.0	26.0
H Ion Conc. pH 6.8		
Total Dissolved Solids	43.0	52.0

Although no analysis of the raw North Santiam River water is available, it should not differ from the above analyses except in its suspended solids content which is partially removed by infiltration.

Supply Facilities

With an estimated headworks capacity of 31 m.g.d., the limiting feature of the supply system is the 19 m.g.d. capacity of the 18-mile long, 36 inch diameter, steel, gravity pipeline. Present rights to North Santiam River are for 22 sec. ft. Negotiations are under way with the Oregon Pulp & Paper Co. for a right to a further supply, but the quantity is as yet undetermined.

Distribution Facilities

The distribution system with steel and cast-iron mains varying from 4 to 30 inches in diameter has proved to be adequate for both domestic and fire purposes, and no restrictions on the use of water have been required. Storage in use is shown in the following table:

Name	Type	Capacity m.g.
Fairmont	Concrete	10.00
Candalaria	"	.50
West Salem	"	.30
* Downs	"	.25
* Superior St.	Steel	.10
* West Salem Tower	Steel	.10
	TOTAL	11.25

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* Auxiliary pumps are used to lift the water to the last three reservoirs which are high level.

Construction Underway

1. A 2 mile 16 inch diameter link in North Salem to improve distribution and provide for future growth. This project is estimated to cost $90,000 and to be completed by November 1951.

2. Normal additions to the distribution system for which the following list of 1950 requirements is considered representative of the immediate future requirements.

2 inch diam., cast-iron pipe . . .	10,000 ft.
6 " " " " " . . .	9,000 ft.
8 " " " " " . . .	8,500 ft.
12 " " " " " . . .	4,500 ft.
24 " " " " " . . .	10,000 ft.

3. A new 100 m.g. reservoir on the main 36-inch supply line, 1/2 mile northeast of Turner. This will be an asphalt-lined open reservoir, and is scheduled for completion during the year 1952, at a cost of $400,000.

Planned Construction (to Year 1960)

1. A new 20 m.g. reservoir to be completed during the next 3 years if material and labor are available.

2. 3 miles of new 24 inch steel pipeline to connect the planned 20 m.g. reservoir (1. above), to the distribution system. About one mile of this pipeline must be installed almost immediately to replace an existing pipe supplying the west side of Salem where it crosses a bridge which is to be destroyed.

3. 9 miles of new 48 inch diameter pipeline from the new 100 m.g. reservoir near Turner to the city.

4. Possible development of a new source of supply from the Willamette River by means of a new pumping and filtration plant on the west side. This will deliver water to the proposed 20 m.g. reservoir. (See 1. above).

APPENDIX 9 -- SECTION 4

CITY OF EUGENE -- WATERWORKS

Description

Eugene obtains its water supply from the McKenzie River at Hayden Bridge 6 miles east northeast of the city. The watershed is covered mainly with virgin forest undergoing various degrees of exploitation, with a small area of agricultural land along the stream immediately above Hayden Bridge. However, due to commercial and recreational activities on the watershed, there is some human pollution of the water as well as some slight silt load which makes filtration desirable. At Hayden Bridge the water is pumped from the river to the filtration plant where it is pre-chlorinated before undergoing sedimentation and filtration through rapid sand filters. After filtration the water is pumped from the clear well through 6 miles of 45 inch diameter steel tar-lined pipe to the city distribution system.

Area Supplied

The Eugene Waterworks supplies all of the City of Eugene, together with 9 water districts which comprise most of the metropolitan area of Eugene with the exception of Springfield.

Water Requirements

Water is supplied by the Eugene Water Board directly to 35,700 people and to 9 water districts serving an additional population of 13,390, for a total population of 54,090. Industrial water use accounts for approximately 55 percent of all water used. Present water demands are as follows:

(a)	Average Daily	9.94 m.g.d.
(b)	Maximum Daily	21.45 m.g.d.
(c)	Average Day Maximum Month (August)	18.21 m.g.d.

Water Rates

Eugene's water rates are based upon a minimum charge according to the size of meter installed, a primary charge and a secondary charge which vary according to the type of user, and separate rates for users inside and outside the city limits. Monthly demand charges vary from $1.15 for 5/8 inch diameter meters to $18.00 for 8 inch diameter meters. For city residential users the primary rate is as follows:

First 400 cu. ft. or less per month at minimum charge.

Over 400 cu. ft. to 1,600 cu. ft. per month at 14¢ per 100 cu. ft.

The secondary rate is 6.5¢ per 100 cu. ft. for all water used over 1,600 cu. ft. per month.

The average effective rate for all water supplied is 10¢ per 100 cu. ft.

Water Quality and Treatment

An analysis of the water as delivered from the new filtration plant is not available at present; however, an analysis of the same river water as delivered by the old filtration plant is shown below.

	Parts Per Million
Silica (SiO_2)	14.
Iron (Fe)	.02
Calcium (Ca)	4.6
Magnesium (Mg)	1.5
Sodium (Na)	2.3
Potassium (K)	.8
Carbonate (CO_3)	.0
Bicarbonate (HCO_3)	10.0
Sulphate (SO_4)	13.
Chloride (Cl)	1.2
Nitrate (NO_3)	.10
Total Dissolved Solids	44.
Total Hardness as Calculated	18.

The new filtration plant has a capacity of 24 m.g.d., with provisions for increasing the capacity to 72 m.g.d. Principal features of the treatment process are as follows:

Pre-treatment	-- Chlorine Lime and Alum
Sedimentation	-- 2 rectangular units Total capacity 25 m.g.d.
Filtration	-- 6 units, Total Capacity 24 m.g.d.
Clear Well Storage	-- Capacity 300,000 gallons
Post treatment	-- None

Supply Facilities

The McKenzie River at Hayden Bridge has a minimum flow of from 1,300 to 1,400 cu. ft. per second. Eugene Water Board has one right to 27 sec. ft., and another right on the basis of a new extended metropolitan area of 90 sec. ft., making a total right to 117 sec. ft. of McKenzie River water.

The new 45 inch diameter, steel, tar-lined main from the filtration plant to the city has a maximum estimated practical capacity of 50 m.g.d. The present pumping installation will deliver 30 m.g.d. at low speed and 40.5 m.g.d. at high speed. The present capacity of the raw water pumps, which pump from the river to the filtration plant, is 35.5 m.g.d. with space for one more 6 m.g.d. pump for future use.

The old 30 inch steel pipeline which delivered unfiltered water from a point a half mile above the present intake to the city is still in existence. At present this line is used intermittently for pumping irrigation water to the Chase Gardens area and the entire installation is maintained in running order. This line can be used to supply unfiltered but chlorinated water to Eugene in an emergency and is maintained mainly with this end in view. This pipeline is capable of delivering 8 m.g.d. to Eugene.

Distribution Facilities

The distribution system contains 8 reservoirs with a total capacity of 22.64 m.g. Capacities, the type of construction, and level of these reservoirs are as follows:

Reservoir Name	Construction	Level	Capacity m.g.
College Hill #2	Concrete	Low	15.00
College Hill #1	Concrete	Low	2.50
College Hill Elevated Tank	Steel	High	.10
Fairmont	Concrete	Low	.50
Fairmont High Level #1	Concrete	High	.14
Skinner Butte	Concrete	Low	3.00
Crest High Level[1/]	Concrete	High	.70
Fairmont High Level #2[1/]	Concrete	High	.70
		TOTAL	22.64

[1/] Under Construction.

Booster Pumps are used to lift the water to the high level reservoirs.

A total of 111 miles of distribution mains varying from 4 inches to 24 inches diameter serve the area adequately, and no restrictions on water use have ever been necessary.

Construction Underway

1. Two new reservoirs with capacities of 0.7 m.g. each are being built at estimated costs of $50,000 and $60,000.

2. Two water districts, East McKenzie and Oakway, which have only recently been organized, are installing their service mains at an estimated cost of $300,000 each. The pipe for these projects is now on delivery.

3. Normal additions to the city system are covered by an annual appropriation of $100,000, all of which is normally used. The water districts are expected to use approximately $75,000 on normal extension of their systems this year (1951).

Construction Planned

1. Chula Vista Reservoir, with a capacity of 5.0 m.g. This will probably be of concrete construction.

2. Kincaid Park Reservoir with a capacity of 0.7 m.g. This will also probably be of concrete construction.

APPENDIX 9 -- SECTION 5

CITY OF SPRINGFIELD -- WATERWORKS

Description

Springfield obtains its water from the Mountain States Power Company on the basis of a yearly franchise under which the company returns 5 percent of the gross revenue to the city.

The present supply is taken from the Willamette River through a mill pond diversion canal at the city boundary and flows by gravity through approximately 2 miles of wood stave pipe to a filtration plant with a capacity of 2-1/2 m.g.d. From the filtration plant the water is pumped to reservoirs for distribution by gravity. The watershed above the junction of the mill pond diversion canal with the Willamette River is largely forest-covered and is undergoing various degrees of exploitation by the lumber industry. Moderate agricultural development, and considerable recreational use of the watershed, together with lumber industry activities cause some human pollution and sediment loads in the raw Willamette River water.

For reasons mainly of economy in operation, the Mountain States Power Company is now in the process of developing a new water source from wells 2,000 ft. south of the southeast corner of the city area. This water appears to be from an underground branch of the North Fork of the Willamette River. Six wells have been drilled to an average depth of 33 feet and pumps are to be installed on each. The wells will deliver water to a new 20 inch steel main, which is almost complete, and which will tie the new system into the existing distribution mains and storage. The new wells have been tested and found to deliver a fairly soft clear supply showing no sign of human pollution.

Area Supplied

The Mountain States Power Company supplies water to the entire area of Springfield.

Water Requirements

Water is supplied through 3,073 services to a total population of 10,760 people, and approximately 70 industrial consumers.

The total water requirements are as follows:

(a)	Average daily	2.73 m.g.d.
(b)	Maximum Day (August 22)	5.60 m.g.d.
(c)	Maximum Hourly	8.65 m.g.d.
(d)	Average Day Maximum Month (August)	3.94 m.g.d.

Water Rates

The water rates are based upon a minimum charge of $0.75 per month, and, as most of the city is not metered, a schedule of rates is based on fixtures, frontages, and public water uses. For example, the first fixture costs $1.00 per month; each faucet costs $1.00 per month; one toilet and one bath cost $1.30 per month. Lawn sprinkling is charged for on a frontage basis at $2.50 for the first 25 feet and 4¢ for each additional foot per season. Water is at present metered to 50 or 60 commercial users. The rates for metered water vary from 25¢ for the first 600 cu. ft. to a flat rate of 5¢ per 100 cu. ft. per month for over 10,000 cu. ft. A minimum charge of from $1.00 for a 1/2 inch meter to $19.00 for a 4 inch meter, per month, is also made on metered services.

The average rate amounts to $1.50 per month per customer.

Water Quality and Treatment

No analysis of the Willamette River water, or the present filtered supply is available. However, an analysis of the new well water is shown below.

		Parts Per Million
Silica (Si)		10.60
Iron (Fe) and Aluminum Oxides (AlO_2)		1.30
Calcium (Ca)		11.22
Magnesium (Mg)		2.32
Sodium (Na)		3.89
Chlorides (Cl)		4.43
Nitrates (NO_3)		.89
Sulfates (SO_4)		2.47
Carbonates (CO_3)		32.06
Dissolved Carbon Dioxide (CO_2)		9.00
Total Hardness Calculated to $CaCo_3$		37.55
pH Value	7.1	

No treatment of the new well water is considered necessary other than chlorination.

The present supply is filtered in rapid sand filters with a capacity of 2-1/2 m.g.d. The filter plant will be left intact for the most part when it goes out of use early in 1951. The present supply is chlorinated after filtration.

Supply Facilities

The present system includes a 2 mile, 16 inch diameter wood stave gravity pipeline from the mill pond diversion canal to the filtration plant. Both the supply line and the filter plant capacity of 2-1/2 m.g.d. fall somewhat short of present requirements.

The new system will include:

(a) 3 - 1,500 g.p.m. pumps

(b) 3 - 500 g.p.m. pumps

(c) 6,000 feet of pressure steel pipeline, 20 inches in diameter, to deliver the pumped water to the distribution system.

The capacity of the new system is expected to be approximately 8.5 m.g.d., and the potential capacity of the new ground water source is estimated at from 17.0 m.g.d. to 21.5 m.g.d.

Distribution Facilities

The new supply main will pump water directly into the distribution system which includes one 1.5 m.g. concrete reservoir and one 50,000 gallon steel tank. Mains vary from 4 inch diameter to 12 inch diameter, and have proved to give adequate service, including fire protection.

Construction Underway

1. The new well supply is approximately 90 percent complete. The new 20 inch diameter pipeline is 90 percent complete. The wells have been drilled, cased, and capped, and are now ready for placement of the pumps, which are already on hand. It is estimated that the total cost of this new well source of supply will be $115,000 complete.

Construction Planned

1. Normal additions to the distribution system are expected to cost $150,000 for the year 1951.

2. Metering of the new supply.

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL* POLLUTION

WILLAMETTE RIVER BASIN

Name and Location	Miles Above Mouth	Sewered Population	Untreated Waste[1] (P.E.)	Treat- ment Provi- ded[2]	Adequacy of Treatment Facilities[3]		Pollution to Water- Course (P.E.)	Treat- ment Needs[4]	Project Status
					Cap'y	Opr.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
OREGON									
WILLAMETTE RIVER									
Cottage Grove	207	3,000	3,500	N	---	---	3,500	NP	Active Planning
Springfield	185	10,000	11,500	N	---	---	11,500	NP	Active Planning
Eugene	182	35,000	110,000	N	---	---	110,000	NP	Active Planning
Junction City	165	1,400	3,200	P	S	S	2,400	---	---
Harrisburg	163	750	800	N	---	---	800	NP	Inactive
Corvallis	132	15,000	40,000	N	---	---	40,000	NP	Active Planning

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

[1] Includes industrial wastes discharged into municipal sewerage systems.

[2] N = None; M = Minor; P = Primary; S = Secondary.

[3] S = Satisfactory; Uns = Unsatisfactory; Un = Undetermined.

[4] NP = New Plant; E = Enlargement; A = Addition; R = Replacement; Un = Undetermined; --- = No project required.

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Adair Village	128	500	500	P	S	S	350	---	---
Albany	120	9,000	24,000	N	---	---	24,000	NP	Active Planning
Monmouth	100	1,500	1,500	P	S	S	2,100	---	Joint Plant
Independence	100	1,500	1,500						
Salem	85	40,000	250,000	N	---	---	250,000	NP	Under Construction
Manbrin Gardens-	82	750	750	P	S	S	500	---	---
Newberg	50	3,600	3,800	P	S	S	2,500	---	---
West Linn	26	2,500	2,500	N	---	---	2,500	NP	Active Planning
Oregon City	26	8,000	8,000	N	---	---	8,000	NP	Final Plans Approved
Oswego	21	3,000	3,000	N	---	---	3,000	NP	Final Plans approved
Milwaukie	19	5,000	5,000	N	---	---	5,000	NP	Under Construction
Portland	10	294,000	403,000	N	---	---	403,000	NP	Under Construction
ROW RIVER									
Dorena Dam	5	300	300	S	S	S	0	---	---

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION -- Page 3
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MIDDLE FORK WILLAMETTE RIVER									
Lowell	18	800	800	S	S	S	120	---	---
MC KENZIE RIVER									
Weyerhaeuser Co. Town	12	600	600	P	S	S	420	---	---
LONG TOM RIVER									
Monroe	14	300	300	N	---	---	300	NP	Inactive
CALAPOOYA RIVER									
Brownsville	32	500	500	N	---	---	500	NP	Active Planning
SANTIAM RIVER									
Sweet Home	42	2,000	2,000	S	S	S	300	---	---
Lebanon	26	5,000	10,000	N	---	---	10,000	NP	Active Planning
THOMAS CREEK									
Scio	7	100	100	M	S	S	0	---	---
NORTH SANTIAM RIVER									
Detroit Dam	56	350	350	S	S	S	50	---	---

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION -- Page 4
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RICKREALL CREEK									
Dallas	12	4,500	6,100	M	Uns	Uns	5,500	R	Under Construction
YAMHILL RIVER									
Grand Ronde	57	500	500	M	S	S	400	---	---
Sheridan	40	1,000	1,000	N	---	---	1,000	NP	Active Planning
Yamhill Labor Camp	15	1,000	1,000	S	S	S	150	---	---
McMinnville	12.5	6,000	8,500	N	---	---	8,500	NP	Final Plans Approved
NORTH FORK YAMHILL RIVER									
Carlton	5	650	850	M	Uns	Uns	750	R	Active Planning
MOLALLA RIVER									
Molalla	13.5	1,000	1,000	N	---	---	1,000	NP	Inactive
PUDDING RIVER									
Silverton	42	3,000	8,000	S	S	S	2,000	---	---
Mt. Angel	26	1,500	3,500	M	Uns	Uns	3,200	R	Active Planning
Woodburn	14	2,000	2,000	M	Uns	Uns	1,500	R	Final Plans Approved

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION--Page 5
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
PUDDING RIVER (Cont.)									
Woodburn School	12	500	500	M	Uns	Uns	400	R	Inactive
Hubbard	10	300	300	M	S	S	200	---	---
TUALATIN RIVER									
Gaston	55	300	300	M	S	S	250	---	---
Forest Grove **	49	4,000	30,000	P	Uns	Uns	0	R	Active Planning
Hillsboro	30	5,000	7,500	S	Uns	S	3,500	E	Active Planning
DAIRY CREEK									
Banks	10	300	300	S	S	S	100	---	---
BEAVERTON CREEK									
Broadmoor	13	400	400	S	S	S	80	---	---
Cedar Hills	10	1,500	1,500	S	S	S	250	---	---
Beaverton	9	2,500	4,500	S	S	S	900	---	---
Cedar Mill Park	8	1,600	1,600	S	Uns	S	400	E	Active Planning

** Wastes presently being used for irrigation.

APPENDIX 9 -- TABLE 1 -- BASIC DATA ON SOURCES OF MUNICIPAL POLLUTION--Page 6
WILLAMETTE RIVER BASIN

(1)	(2)	(3) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FANNO CREEK									
Vermont Hills	10	350	350	M	Uns	Uns	100	R	Active Planning
CEDAR CREEK									
Sherwood	9	500	3,700	S	S	Un	600	---	---
CLACKAMAS RIVER									
Estacada	24	600	600	P	S	S	420	---	---
Gladstone	1	2,000	2,000	N	---	---	2,000	NP	Active Planning
JOHNSON CREEK									
Gresham	14	3,000	12,000	S	Uns	Uns	6,000	E	Inactive
TOTALS		488,450	985,500				920,040		

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL* POLLUTION

WILLAMETTE RIVER BASIN

Name and Location	Miles Above Mouth	Type Industry	Type of Waste Produced[1]	Treatment or Other Pollution Control Measures			P.E. (B.O.D.) Discharged to Water-Course	Pollution Abatement Need[4]	Current Status Industrial Action
				Degree[2]	Adequacy[3]				
					Cap'y.	Opr.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER									
Culver Slaughter House Cottage Grove	207	Meat Products	O	S	S	S	0	N	---
Bartels Slaughter House Cottage Grove	"	" "	O	S	S	S	0	N	---
Gates Market Cottage Grove	"	" "	O	S	S	S	0	N	---
McKenzie Meat Co. Springfield	185	" "	O	P	Uns	Uns	250	A	Inactive
Oregon Fibre & Flax Springfield	"	Flax Mill	O	S	S	S	0	N	---

---

* Industries having separate outlets and discharging wastes directly to watercourse.

[1] O = Organic; Ino = Inorganic; S = Sanitary Sewage Only; Un = Undetermined.

[2] N = None; M = Minor; P = Primary or equivalent; S = Secondary or equivalent; Un = Undetermined.

[3] S = Satisfactory; Uns = Unsatisfactory; Un = Undetermined.

[4] NP = New Plant; E = Enlargement; A = Addition; R = Replacement; C = Connection to municipal system; N = None; Un = Undetermined.

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 2
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Willamette Wood Chemicals, Springfield	185	Chemicals & Allied Products	0	N	---	---	Un	Un	Undetermined
R. H. Bauer Eugene	182	Canning & Preserving	0	S	S	S	0	N	---
Brunners Dryer Eugene	"	Canning & Preserving	0	S	S	S	0	N	---
Oregon Turkey Growers Eugene	"	Meat Products	0	P	Uns	Uns	3600	E	Inactive
Mayberry Chapman Meat Co., Eugene	"	" "	0	S	Uns	Uns	0	E	Inactive
Eugene Chemical Eugene	"	Meat Products	0	N	---	---	Un	NP	Inactive
Irish McBroom Meat Co. Eugene	"	" "	0	S	Uns	S	300	E	Inactive
A. J. Flint Junction City	165	" "	0	S	S	S	0	N	---
Junction City Creamery Junction City	"	Dairy Products	0	S	S	S	0	N	---

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 3
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Anderson & Son Harrisburg	163	Meat Products	0	S	S	S	0	N	---
Monroe St. Cash Market Corvallis	132	" "	0	S	S	S	0	N	---
Sanitary Meat Market Corvallis	"	" "	0	S	S	S	0	N	---
Albany Foods, Inc. Albany	120	Canning & Preserving	0	P	Uns	Uns	0	R	Inactive
Steen Bros. Albany	"	Meat Products	0	P	Uns	Uns	1500	R	Inactive
Borden Co. Albany	"	Dairy Products	0	N	---	---	1000	C	Active Planning (City Sewer)
Nebergall Meat Co. Albany	"	Meat Products	0	N	---	---	5600	NP	Active Planning
City Meat Market Independence	100	" "	0	S	S	S	0	N	---
Wade Meat Co. Independence	"	" "	0	S	S	S	0	N	---

APPENDIX 9.— TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 4
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Honeywood Distillers Salem	85	Distillery	0	Un	Un	Un	Un	Un	Undetermined
Aufranc Custom Cannery Salem	"	Canning & Preserving	0	S	S	S	0	N	---
Ried Murdock Co. Salem	"	" "	0	N	---	---	32500	C	Active Planning (To City Sewer)
United Growers, Inc. Salem	"	" "	0	S	S	S	0	N	---
West Foods, Inc. Salem	"	" "	0	S	S	S	0	N	---
Oregon Pulp & Paper Co. Salem	"	Pulp & Paper Products	0	N	---	---	860000	NP	Active Planning (Lagoon)
Consolidated Chemicals Salem	"	Chemicals & Allied Products	Un	Un	Un	Un	Un	Un	Undetermined
J. G. McKillip Co. St. Paul	57	Meat Products	0	S	S	S	0	N	---
St. Paul Flax Growers St. Paul	"	Flax Mill	0	S	Un	Un	Un	Un	Undetermined

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 5
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Hudson Duncan Cannery Dundee	55	Canning & Preserving	0	S	S	S	0	N	---
Spaulding Pulp & Paper Co. Newberg	50	Pulp & Paper Products	0	N	---	---	495000	NP	Active Planning
Crown Willamette Co. West Linn	26	" "	0	N	---	---	831000	NP	" "
Publishers Paper Co. Oregon City	"	" "	0	N	---	---	556000	NP	" "
M & S Canning Co. Milwaukie	19	Canning & Preserving	0	S	Uns	Uns	Un	R	Inactive
General Paint Co. Portland	10	Chemicals & Allied Products	Ino	Un	Un	Un	Un	Un	Undetermined
Portland Woolen Mills Portland	"	Textile Mill	Un	Un	Un	Un	Un	Un	"
Pacific Roofing Co. Portland	"	Paperboard & Other Products	0	N	---	---	2800	NP	"

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 6
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
WILLAMETTE RIVER (Cont.)									
Volney Felt Mills Inc. Portland	10	Textile Mill	O	N	---	---	6000	NP	Undetermined
Portland Gas & Coke Co. Portland	10	Products of Petroleum & Coal	Ino	P	Uns	Uns	Un	R	Inactive
Pennsylvania Salt Mfg. Co. Portland	5	Chemical & Allied Products	Ino	N	---	---	Un	Un	Undetermined
Oregon Shipyards Portland	1	Miscellaneous	S	N	---	---	600	Un	Undetermined
McKENZIE RIVER									
Weyerhaeuser Pulp Mill Weyerhaeuser Co. Town	12	Pulp & Paper Products	O	N	---	---	50000	Un	Undetermined
LONG TOM RIVER									
Benton County Flax Growers Monroe	12	Flax Mill	O	S	Uns	Un	Un	E	Inactive
CALAPOOYA RIVER									
Brownsville Mills Brownsville	32	Textile Mill	O	N	---	---	Un	NP	Inactive

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 7
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SANTIAM RIVER									
Crown Willamette Co. Lebanon	26	Pulp & Paper Products	0	N	---	---	109000	NP	Active Planning
THOMAS CREEK									
Santiam Flax Growers Scio	6	Flax Mill	0	S	S	S	0	N	---
NORTH SANTIAM RIVER									
Western Bolt & Bedding Co. Stayton	26	Textile Mill	0	Un	Un	Un	Un	Un	Undetermined
Paris Woolen Mills Stayton	"	" "	Un	N	---	---	Un	Un	"
Stayton Cannery Stayton	"	Canning & Preserving	0	M	S	S	0	N	---
RICKREALL CREEK									
Ediger Dehydrating Co. Dallas	12	Canning & Preserving	0	S	S	S	0	N	---
Carl Gerlinger Co. Dallas	"	" "	0	S	S	S	0	N	---

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 8
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RICKREALL CREEK, (Cont.)									
Minty Dehydrator Co. Dallas	12	Canning & Preserving	0	S	S	S	0	N	---
Muil & McDonald Tannery Dallas	"	Leather & Leather Products	0	S	S	S	0	N	---
YAMHILL RIVER									
Kings Market McMinnville	12.5	Meat Products	0	S	S	S	0	N	---
McMinnville Meat Co. McMinnville	"	" "	0	S	S	S	0	N	---
Alderman Farms Dayton	6	Canning & Preserving	0	S	S	S	0	N	---
Dayton Flax Growers Dayton	"	Flax Mill	0	S	S	S	Un	N	---
MOLALLA RIVER									
Molalla Flax Growers Molalla	18	Flax Mill	0	S	S	S	0	N	---

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 9
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MOLLALA RIVER (Cont.)									
Clackamas Flax Growers Canby	4	Flax Mill	0	S	S	S	0	N	---
Oregon Turkey Growers Canby	"	Meat Products	0	S	S	S	0	N	---
PUDDING RIVER									
Silverton Flax Company Silverton	42	Flax Mill	0	S	S	S	0	N	---
Mt. Angel Meat Company Mt. Angel	26	Meat Products	0	S	S	S	0	N	---
Mt. Angel Flax Growers Mt. Angel	"	Flax Mill	0	N	---	---	6000	NP	Inactive
General Foods, Inc. Woodburn	14	Canning & Preserving	0	P	Uns	Uns	35000	E	Inactive
TUALATIN RIVER									
Forest Fibre Products Gaston	55	Paperboard & Other Products	0	P	Uns	Uns	30000	R	Active Planning

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 10
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
TUALATIN RIVER (Cont.)									
Arrow Meat Co. Cornelius	36	Meat Products	0	S	S	S	0	N	---
Jacobs Mullen Co. Cornelius	"	" "	0	S	S	S	0	N	---
Cornelius Custom Cannery Cornelius	"	Canning & Preserving	0	S	S	S	0	N	---
Hillsboro Meat Co. Hillsboro	30	Meat Products	0	Un	Un	Un	Un	Un	Undetermined
Chandler & Co. Tigard	10	Canning & Preserving	0	Un	Un	Un	Un	Un	"
Kraft Food Co. Tigard	"	Dairy Products	0	N	---	---	Un	Un	"
Tualatin Canning Co. Tigard	9	Canning & Preserving	0	S	Un	Un	Un	Un	"
Westward Packing Co. Tigard	"	" "	0	S	S	S	0	N	---

APPENDIX 9 -- TABLE 2 -- BASIC DATA FOR SOURCES OF INDUSTRIAL POLLUTION--Page 11
WILLAMETTE RIVER BASIN

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DAIRY CREEK									
Kelly Farquhar Co. Banks	10	Canning & Preserving	0	P	Uns	Uns	Un	R	Inactive
Bodle Co. Banks	"	" "	0	N	---	---	Un	NP	"
H. N. Kumner Meat Co. Hillsboro	"	Meat Products	0	P	Uns	Uns	2000	R	"
FANNO CREEK									
Alpenrose Dairy Vermont Hills	12	Dairy Products	0	N	---	---	Un	NP	Inactive
Fulton Park Dairy Vermont Hills	13	" "	0	N	---	---	Un	NP	"
CLACKAMAS RIVER									
Sunnyside Tannery Estacada	24	Leather & Leather Products	0	S	S	S	0	N	---
Clackamas Meat Co. Estacada	"	Meat Products	0	S	S	S	0	N	---
TOTAL							3,028,150		

APPENDIX 9 - TABLE 3

Physical Characteristics of Willamette River

Location on Stream	Miles from Mouth	Low-Water Elevation Feet. m.s.l.	Slope (ft.) Per Mile
Mouth of Willamette River	0.0	1.10	
Oswego	20.1	1.89	0.04
Below Willamette Falls	26.2	2.45	0.10
Above Willamette Falls	26.6	49.90	Falls
Mouth of Yamhill River	54.9	53.85	0.14
Corvallis	131.8	191.80	1.80
Two Miles above Mouth of Long Tom River	152.0	248.70	2.83
Harrisburg	163.0	292.70	4.40
Three Miles above Mouth of McKenzie River	180.0	390.30	5.74
Eugene	182.2	396.50	2.82
Two Miles above Eugene	184.2	422.10	12.30
Mouth of Middle Fork Willamette River	188.3	434.50	3.03

Source: Adapted from Table in Corps of Engineers
Columbia River and Tributaries Review Report.

APPENDIX 9 - TABLE 4

Physical Characteristics of Main Tributaries

River	Mouth (River Miles)	Length[1] (Miles)	Drainage Area (Sq. Miles)	Approximate Avg. Slope Ft. per Mi.
East Side				
Middle Fk. Willamette	W-188	78	1,360	36
McKenzie	W-176	87	1,320	31
Calapooya	W-120	70	362	20
Santiam	W-109	12	1,820	5
South Santiam	S- 12	66	Included Above	23
North Santiam	S- 12	82	Included Above	40
Molalla	W- 36	42	890[2]	60
Pudding	M- 1	60	---	12
Clackamas	W- 25	77	930	43
West Side				
Coast Fk. Willamette	W-188	37	670[3]	14
Row	CFW- 19	20	---	25
Long Tom	W-150	47	410	6.4
Marys	W-132	47	300	32
Luckiamute	W-108	49	310	47
Rickreall Creek	W- 89	22	106	24
South Yamhill	W- 55	64	770	7.3
North Yamhill	SY- 11	27	Included Above	34
Tualatin	W- 28	86	710	33

Source: Adapted from Corps of Engineers
Columbia River and Tributaries Review Report.

[1] Lengths shown are profile lengths shown on plates included in Corps of Engineers report on Columbia River and Tributaries and are not necessarily the total length of the stream.

[2] Includes Drainage Area of Pudding River.

[3] Includes Drainage Area of Row River.

APPENDIX 9 - TABLE 5

Climatological Data (through 1945)

Station	Elev. in Feet	Precipitation in Inches			Average Annual Snow-fall Inches	Temperature °F			Average Length Growing Season
		Average Annual	Max.	Min.		Mean Annual	Max.	Min.	
Albany	212	41	59.6	24.3	7.3	52.8	104	-15	210*
Corvallis	266	39	58.1	23.0	7.1	52.4	107	-14	210*
Cottage Grove	650	43	62.2	29.0	5.6	51.8	105	- 8	195*
Dallas	325	46	69.6	30.1	10.9	51.4	105	17	210*
Detroit	1452	70	91.0	43.5	55.2	48.9	104	- 2	120*
Eugene	450	38	55.2	24.0	5.6	52.5	104	- 4	205
Forest Grove	220	46	61.5	26.1	14.3	51.7	108	-15	210*
Hillsboro	203	34	51.1	25.0	9.0	52.0	105	- 2	210*
McKenzie Bridge	1372	68	86.1	43.4	14.1	50.1	108	- 3	120*
McMinville	150	43	57.8	24.5	10.1	52.3	110	-24	210*
Newberg	400	49	63.1	33.5	7.8	52.0	103	2	210*
Oakridge	1313	38	51.7	28.4	14.8	53.0	112	0	180*
Portland	30	42	67.2	26.1	12.9	53.1	107	- 2	263
Salem	164	38	63.5	24.6	7.6	52.7	108	- 6	213

Source: Corps of Engineers Columbia River and Tributaries Review Report except for growing seasons marked by (*). These values were obtained from the Economic Atlas of the Pacific Northwest, 2d Ed., of the Northwest Regional Council.

APPENDIX 9 -- TABLE 6
CRITICAL MONTHS' STREAM FLOW
Cu. Ft./ Sec.

Water Year	Willamette River at Eugene Drainage Area: 2,030 Sq.Mi.				Willamette River at Albany Drainage Area: 4,840 Sq.Mi.			
	Aug.	Sept.	Oct.	Mean Annual	Aug.	Sept.	Oct.	Mean Annual
1926	758	890	1,400	3,457	2,320	2,480	3,500	9,558
1927	865	1,420	2,990	6,346	3,110	3,960	8.030	16,988
1928	979	792	900	5,837	2,600	2,490	2,840	15,008
1929	902	686	663	3,678	2,970	2,390	2,460	10,333
1930	682	684	880	3,485	2,450	2,280	2,630	9,365
1931	603	621	1,280	2,786	2,300	2,150	3,720	7,993
1932	966	752	981	5,783	3,200	2,730	3,080	15,473
1933	1,110	1,150	1,046	6,121	4,000	3,740	3,697	16,035
1934	636	614	1,807	3,087	2,467	2,238	4,637	9,819
1935	764	682	935	5,608	2,820	2,664	3,063	14,500
1936	862	831	659	4,782	3,010	2,758	2,313	12,776
1937	1,027	927	1,672	4,925	3,619	3,128	4,309	13,130
1938	809	749	871	6,646	2,878	2,737	2,924	17,965
1939	788	736	1,058	4,165	2,645	2,503	2,932	10,881
1940	547	811	985	3,409	2,034	2,352	2,785	9,731
1941	387	1,342	1,380	3,050	2,589	3,698	3,295	8,164
1942	934	735	792	4,941	3,147	2,820	2,629	12,635
1943	1,259	1,134	2,420	7,961	4,115	3,421	6,275	20,200
1944	751	997	912	3,322	2,485	2,623	2,840	8,691
1945	869	1,163	898	4,621	2,823	3,189	3,567	12,335
Avg.	850	886	1,226	4,700	2,879	2,817	3,576	12,579

Source: Corps of Engineers

APPENDIX 9 — TABLE 7
CRITICAL MONTHS' STREAM FLOW
Cu. Ft./ Sec.

	Willamette River at Salem Drainage Area: 7,280 Sq.Mi.				Willamette R. at Oregon City Drainage Area: 10,098 Sq.Mi.			
Water Year	Aug.	Sept.	Oct.	Mean Annual	Aug.	Sept.	Oct.	Mean Annual
1926	3,000	3,400	5,200	15,450	3,370	4,890	7,440	19,089
1927	4,500	6,100	14,600	26,267	4,540	8,100	17,780	34,186
1928	3,650	3,590	4,210	24,478	3,960	3,860	4,920	30,632
1929	3,810	3,390	3,290	16,661	4,170	3,640	3,620	20,068
1930	3,050	3,030	3,970	15,293	3,360	3,300	4,420	18,486
1931	2,950	2,680	5,120	13,696	3,190	2,960	6,020	17,075
1932	4,310	3,330	4,830	24,624	4,670	3,560	5,370	31,330
1933	5,100	5,960	5,888	25,974	5,530	6,780	7,160	32,524
1934	3,209	2,947	8,624	17,700	3,500	3,260	10,390	23,535
1935	3,706	3,397	4,403	23,726	4,010	3,690	4,970	30,323
1936	3,899	3,708	3,214	20,779	4,260	4,060	3,520	25,327
1937	4,792	4,133	6,836	21,278	5,290	4,680	7,870	26,012
1938	3,632	3,461	3,756	29,539	3,960	3,790	4,290	37,177
1939	3,311	3,300	4,447	17,370	3,530	3,572	4,940	20,899
1940	2,653	3,137	4,296	16,865	2,870	3,450	5,100	24,025
1941	3,445	6,190	6,835	13,676	3,740	7,130	8,070	16,885
1942	4,071	3,490	3,365	20,535	4.670	3,820	3,710	25,255
1943	5,455	4,585	10,760	32,115	5,860	4,890	12,930	39,746
1944	3,194	3,347	3,609	14,552	3,430	3,630	3,950	17,724
1945	3,466	4,152	4,463	20,368	3,760	4,810	6,250	24,679
Avg.	3,760	3,866	5,586	20,547	4,084	4,394	6,636	25,749

Source: Corps of Engineers

APPENDIX 9 -- TABLE 8

STREAM FLOW CHARACTERISTICS

Stream:	Willamette	Willamette	Willamette	Willamette	Long Tom	Molalla	Pudding	Tualatin
Location:	Eugene	Albany	Salem	Oregon City	Monroe	Canby	Aurora	Near Willamette
Period Considered:	1926-45	1926-45	1926-45	1926-45	1928-47	1929-46	1929-46	1929-46
Drainage Area (Sq. Miles):	2,030	4,840	7,280	10,098	391	323	493	710
Percent of Total Stream Drainage:	18	43	65	90	96	36	--	100
Critical Months (Cu.Ft. per Sec.):	Aug.-Oct.	Aug.-Oct.	Aug.-Oct.	July-Sept.	July-Sept.	July-Sept.	July-Sept.	July-Sept.
Daily Minimum:	500	1,840	2,470	--	7	38	37	38
Single Month Min.:	547	2,034	2,653	2,870	12	50	50	42
Minimum 3 Months (Average):	749	2,390	3,025	3,670	14	75	61	64
3 Months Mean:	986	3,091	4,400	5,038	55	130	105	107

Source: Corps of Engineers and U.S.G.S.

APPENDIX 9 -- TABLE 9

LAND DISTRIBUTION BY USE

1940

Agricultural Land	2,112,330 Acres
Forest Land	4,589,130 Acres
Miscellaneous and Other Uses	466,540 Acres
Total Land in Basin	7,168,000 Acres

Adapted from Corps of Engineers Columbia River and Tributaries Review Report

APPENDIX 9 -- TABLE 10

PUBLIC LANDS AND RESERVATIONS

1948

National Forests	2,250,000 Acres
Public Domain	750,000 Acres
State Parks	2,998 Acres
Municipal Areas	10,000 Acres
Total Land in Basin	3,012,998 Acres

Adapted from Corps of Engineers Columbia River and Tributaries Review Report.

APPENDIX 9 -- TABLE 11

AGRICULTURAL RESOURCES

1945

Number of Farms	32,133
Average Size of Farms, Acres	84
Land in Farms:	
Total Acres	2,680,728
Percent of Land in Area	37%
Cropland, Acres	1,325,863
All Other Uses, Acres	1,354,865
Value of Land and Buildings:	
Per Acre, Dollars	$ 118
Total ($1,000)	$ 316,574

Source: Adapted from table in Corps of Engineers Columbia River and Tributaries Review Report.

APPENDIX 9 -- TABLE 12

GROSS FARM INCOME

1944

Livestock and Livestock Products Sold	$ 43,289,000
Crops Sold	$ 51,574,000
Forest Products Sold	$ 984,000
Farm Products Used by Farm Households	$ 8,626,000
Total Gross Income	$104,473,000

Source: Adapted from table in Corps of Engineers Columbia River and Tributaries Review Report.

APPENDIX 9 -- TABLE 13

POPULATION DISTRIBUTION AND TRENDS

County[1]	Percent of County Area in Basin	Percent of 1940 Population in Basin	Population				Percent Increase			1950 Population	
			1920	1930	1940	1950	1920-1930	1930-1940	1940-1950	Urban	Rural[2]
OREGON											
Benton	86	96	12,218	15,870	17,858	30,263	30	13	70	16,173	14,090
Clackamas	81	98	37,698	46,205	55,976	84,800	22	21	52	19,118	65,682
Lane	78	92	34,548	52,552	63,829	115,000	52	21	80	49,964	65,036
Linn	100	100	24,550	24,700	30,485	53,622	--	23	76	19,525	34,097
Marion	100	100	47,187	60,541	75,246	100,379	28	24	33	45,530	54,849
Multnomah	17	74	204,168	250,301	261,569	368,500	22	5	41	275,000	93,500
Polk	86	100	14,181	16,858	19,989	26,184	19	19	31	7,791	18,393
Washington	85	100	26,376	30,275	39,194	61,221	15	29	56	11,958	49,263
Yamhill	91	100	20,529	22,036	26,336	33,410	7	20	27	10,527	22,883
Basin Total			421,455	519,338	590,482	873,379	23	14	48	455,226	417,793

---

[1] Small populations of Polk, Washington and Yamhill Counties lying outside of subbasin included in total population for Counties.

[2] Including communities of 2,500 persons or less.

Source: U. S. Census.

APPENDIX 9 -- TABLE 14

INDUSTRIAL DISTRIBUTION OF EMPLOYED PERSONS

1940

Industry	Number Employed	Percent of Total
Extractive Industries:		
Agriculture	33,208	14
Logging	7,488	3
Forestry	626	*
Mining	573	*
Total Extractive Industries	41,895	17
Processing Industries:		
Saw & Planing Mills	11,198	5
Other Wood Products	6,377	3
Food & Kindred Products	6,995	3
Textiles	2,326	*
Nonferrous Metals	616	*
Iron & Steel	2,729	1
Stone & Clay Products	602	*
Printing & Publishing	4,059	2
Machinery & Transportation Equipment	2,800	1
Other Manufacturing	17,895	7
Total Processing Industries	55,597	22
Service Industries:		
Construction	13,323	5
Transportation	15,722	6
Wholesale & Retail Trade	52,707	22
Professional & Government	32,055	13
Communication & Utilities	6,211	3
Miscellaneous Services	25,189	10
Total Service Industries	145,207	59
Industries Not Classified	4,553	2
Total Employed	247,252	100

* Less than 1 percent.

Source: Table in Corps of Engineers Columbia River and Tributaries Review Report.

APPENDIX 9 -- TABLE 15

UNRESERVED SAW TIMBER, JAN. 1, 1945

Million Board Feet, Log Scale, Scribner Rule	
Privately Owned	24,942
National Forests	34,346
Other Publicly Owned and Managed	6,076
Total	65,364

Source: Adapted from table in Corps of Engineers *Columbia River and Tributaries Review Report*.

APPENDIX 9 -- TABLE 16

LUMBER PRODUCTION, 1941-48[1]

Year	Thousands of Board Feet
1941 [2]	2,459,179
1942 [2]	2,609,225
1943 [2]	2,542,712
1944 [2]	2,526,027
1945 [2]	2,054,232
1946 [2]	2,498,940
1947 [3]	3,385,882
1948 [3]	3,250,187

[1] Includes all lumber produced in the 9 counties which lie wholly or principally within subbasin.

[2] Table Corps of Engineers *Columbia River and Tributaries Review Report*.

[3] Pacific Northwest Forest and Range Experiment Station.

APPENDIX 9 -- TABLE 17

MANUFACTURING

1947

Establishments	1,703
Wage Earners (Average)	57,844
Wages	$ 171,530,000
Value added by Manufacturing	$ 356,210,000

Source: Census of Manufacturers, 1947 -- U. S. Department of Commerce.

APPENDIX 9 -- TABLE 18

MUNICIPAL WATERWORKS[1]

Name	Population Served	Source of Supply	Estimated Water Consumption m.g.d. Ave. Daily	 Summer Month Ave. Daily	Treatment
(1)	(2)	(3)	(4)	(5)	(6)
Surface Water					
Portland	478,000	Bull Run River	56.38	104.20	Chlorination
Eugene	54,090	McKenzie River	9.94	18.21	Filt. & Chlorination
Salem[2]	48,520	North Santiam River	8.86	15.73	Inf. Gal. Chlorination
Corvallis	17,500	Willamette River and Tributaries	3.06	5.42	Filt. & Chlorination
Oregon City— West Linn	11,360	Memaloose Creek & South Fork Clackamas River	2.55	3.00	Chlorination
Springfield	10,760	Willamette River	2.73	3.94	Filt. & Chlorination
Albany	10,000	South Santiam River	2.29	3.75	Filt. & Chlorination
Hillsboro[2]	10,000	Seine & Scotland Creeks-- Tualatin River	1.50	3.50	Chlorination
McMinnville	6,600	Hoskins Creek	1.78	2.96	Chlorination
Dallas	6,300	Rickreall, Canyon and Applegate Creeks	0.41	0.61	Chlorination
Lebanon	5,800	South Santiam River	2.50	3.63	Coagulation-Sedimentation; Chlorination

[1] Includes waterworks supplying 200 or more people.

[2] Has Supplemental Well or Spring Supply.

APPENDIX 9 -- TABLE 18 - MUNICIPAL WATERWORKS -- Page 2

(1)	(2)	(3)	(4)	(5)	(6)
Surface Water (Cont.)					
Silverton[2]	5,000	Abiqua Creek	1.00	1.88	Chlorination
Cottage Grove	4,400	Dinner, Prather & Laying Creeks	1.00	1.67	Chlorination
Forest Grove	4,400	Gales & Tyler Creeks	0.81	1.90	Filt. & Chlorination
Sweet Home	3,600	South Santiam River	0.42	0.70	Filt. & Chlorination
Sheridan[2]	2,640	Baltimore Creek	0.25	0.42	Chlorination
Monmouth[2]	1,940	Thiel Creek	0.29	0.48	Chlorination
Mill City	1,800	North Santiam River	0.27	0.45	Chlorination
Willamina	1,660	Lady & Willamina Creeks	0.25	0.42	Chlorination
Carlton	1,600	Panther Creek	0.24	0.40	Chlorination
Oakridge	1,550	Salmon Creek	0.23	0.39	Chlorination
Falls City	1,200	Thiel Creek	0.18	0.30	Chlorination
Estacada	1,140	North Fork Clackamas River	0.20	0.33	Chlorination
Yamhill	800	Turner Creek	0.12	0.20	Chlorination
Wendling	720	Wolf Creek	0.11	0.18	Filt. & Chlorination
Adair Village	500	Willamette River	0.08	0.13	Filt. & Chlorination
Grand Ronde	300	Rock Creek	0.05	0.08	Chlorination
Detroit	250	Mackey Creek	0.04	0.06	None
Colton	200	Canyon Creek	0.03	0.05	Chlorination
Total Surface	693,630		97.57	174.96	

APPENDIX 9 -- TABLE 18 -- MUNICIPAL WATERWORKS -- Page 3

(1)	(2)	(3)	(4)	(5)	(6)
Ground Water					
Newberg	8,000	Springs & Wells	1.20	2.00	Chlorination
Milwaukie	5,250	Wells	0.41	1.05	None
Salem State Inst'ns.	4,000	Wells	0.47	1.10	None
Woodburn	3,600	Wells	0.54	0.90	None
Oswego	3,310	Wells	0.60	1.20	None
Independence	2,600	Wells	0.39	0.65	Chlorination
Beaverton	2,500	Wells	0.25	0.42	Chlorination
Junction City	1,800	Wells	0.27	0.45	Chlorination
Canby	1,670	Springs & Wells	0.16	0.26	Chlorination
Mt. Angel	1,630	Wells	0.24	0.41	None
Lake Grove	1,620	Wells	0.24	0.40	None
Tigard	1,600	Wells	0.24	0.40	None
Stayton	1,520	Inf. Gal.	0.23	0.38	None
Molalla	1,490	Wells	0.22	0.37	Chlorination
Brownsville	1,470	Wells	0.22	0.36	Chlorination
Russelville W.D.	1,220	Wells	0.18	0.30	None
Dayton	1,200	Spring & Well	0.18	0.30	Chlorination
Harrisburg	1,010	Spring & Well	0.15	0.25	Chlorination
Amity	1,000	Spring & Well	0.15	0.25	Chlorination
Creswell	1,000	Well	0.15	0.25	Chlorination
Lafayette	850	Springs	0.13	0.21	None
Sherwood	800	Wells	0.22	0.36	None
Park Place	800	Springs	0.12	0.20	Chlorination
Coburg	690	Well	0.10	0.17	None

APPENDIX 9 — TABLE 18 — MUNICIPAL WATERWORKS -- Page 4

(1)	(2)	(3)	(4)	(5)	(6)
Ground Water (Cont.)					
Jefferson	630	Wells	0.10	0.16	Chlorination
Manbrin Gardens	630	Wells	0.06	0.13	Chlorination
Marcola	600	Well	0.09	0.15	None
Multnomah County Farm	600	Springs & Well	0.09	0.15	None
Westfir	600	Wells	0.09	0.15	Chlorination
Hubbard	540	Wells	0.08	0.14	None
Scio	540	Wells	0.08	0.14	None
Chemawa Indian School	500	Well	0.05	0.10	None
Aurora	460	Wells	0.07	0.12	None
Gervais	450	Wells	0.07	0.12	None
Salem Cottage Farm	400	Well	0.06	0.10	None
Tualatin	400	Well	0.06	0.10	None
Halsey	390	Well	0.06	0.10	Chlorination
Banks	380	Springs	0.06	0.10	None
Capitola	380	Wells	0.04	0.08	Chlorination
Mulino	380	Springs & Well	0.06	0.10	Chlorination
Sublimity	370	Well	0.05	0.09	Chlorination
Monroe	360	Springs	0.05	0.09	None
North Plains	360	Well	0.05	0.09	None
Cherry Grove	310	Spring	0.04	0.08	Chlorination
Dundee	310	Springs	0.04	0.08	None
Demaskey	300	Wells	0.03	0.06	Chlorination
Scotts Mills	260	Springs	0.04	0.07	Chlorination
Orenco	250	Well	0.04	0.06	None
Saint Paul	240	Wells	0.04	0.06	None

APPENDIX 9 — TABLE 18 — MUNICIPAL WATERWORKS — Page 5

(1)	(2)	(3)	(4)	(5)	(6)
Ground Water (Cont.)					
Sunnyview	230	Wells	0.02	0.04	Chlorination
Carlhaven	210	Wells	0.02	0.04	Chlorination
Corvallis W.C.T.U.	200	Well	0.03	0.05	None
Total Ground Water	61,910		8.63	15.39	
GRAND TOTAL	754,540		106.20	190.35	

APPENDIX 9 -- TABLE 19

INDUSTRIAL WATERWORKS

Type & Name of Industry	Location	Source of Supply	Max. Daily Water Requirement m.g.d.	Part of Total Used As Cooling Water m.g.d.	Treatment	
					Type	Capacity m.g.d.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
SURFACE WATER	OREGON					
Food & Kindred Products						
Borden Co.	Albany	Willamette River	.820	.820	Undetermined	Undetermined
Subtotal			.820	.820		
Textile Mill Products						
Portland Woolen Mills	Portland	Willamette River	1.150	None	None	None
Clackamas Flax Growers	Canby	Molalla River	.120	None	None	None
Subtotal			1.270	0.00		
Lumber & Wood Products						
Roseboro Lumber Co.	Springfield	Middle Fork Div., Willamette River	2.880	2.88	None	None

APPENDIX 9 — TABLE 19 — INDUSTRIAL WATERWORKS — Page 2

(1)	(2)	(3)	(4)	(5)	(6)	(7)
SURFACE WATER (CONT.)						
Lumber & Wood Products (Cont.)						
Springfield Plywood Co.	Springfield	Middle Fork Div., Willamette River	2.880	2.88	None	None
Forest Fibre Products	Gaston	Tualatin River	.500	Undeter.	Undetermined	Undetermined
Subtotal			6.260	5.76		
Paper & Allied Products						
Crown Willamette Co.	West Linn	Willamette River	40.800	2.00	Filtration--Chlorination	12.0
Weyerhaueser Pulp & Paper Mill	Springfield	McKenzie River	28.800	28.800	Chemical Sedimentation	10.6
Oregon Pulp & Paper Co.	Salem	North Santiam River Diversion	28.000	2.800	Sand Filtration--Chlorination	14.0
Publishers Paper Co.	Oregon City	Willamette River	20.000	10.000	None	----
Spaulding Pulp & Paper Co.	Newberg	Willamette River	4.320	.720	Sand Filtration	4.5
Crown Willamette Co.	Lebanon	Canal	3.500	.430	Settling Basin	1.5
Subtotal			125.420	44.750		

APPENDIX 9 -- TABLE 19 -- INDUSTRIAL WATERWORKS -- Page 3

(1)	(2)	(3)	(4)	(5)	(6)	(7)
SURFACE WATER (CONT.)						
Chemicals & Allied Products						
Pennsylvania Salt Mfg. Co.	Portland	Willamette River	17.300	17.300	None	----
Consolidated Chemicals	Salem	Willamette River	4.320	4.320	None	----
Subtotal			21.620	21.620		
Products of Petroleum & Coal						
Portland Gas & Coke Co.	Portland	Willamette River	12.960	12.960	None	----
Subtotal			12.960	12.960		
Stone Clay and Glass Products						
Walling Sand & Gravel	Salem	Willamette River	.39	----	None	----
Subtotal			.39	0.00		
Electrical Machinery, Equipment & Supplies						
Mountain States Power Co.	Springfield	Willamette River, North Fork Div.	5.03	5.03	None	----
Subtotal			5.03	5.03		
TOTAL SURFACE WATER			173.770	90.940		

APPENDIX 9 -- TABLE 19 -- INDUSTRIAL WATERWORKS -- Page 4

(1)	(2)	(3)	(4)	(5)	(6)	(7)
GROUND WATER						
Food & Kindred Products						
Libby McNeill & Libby Co.	Portland	Wells	2.020	----	Undetermined	----
California Packing Co.	Salem	Wells	.870	----	"	----
Gresham Berry Growers	Gresham	Wells	.770	----	"	----
Damascus Milk Co.	Portland	Wells	.600	----	"	----
General Foods Inc.	Woodburn	Wells	2.250	----	"	----
West Foods Inc.	Salem	Wells	1.670	----	"	----
Alderman Farms	Dayton	Wells	1.50	----	"	----
United Growers	Salem	Wells	.690	----	"	----
Stayton Canning Corp.	Stayton	Wells	.720	.060	"	----
Reid Murdock Co.	Salem	Wells	.480	.240	"	----
Dairy Coop. Ass'n.	Salem	Wells	.250	.480	"	----
Producers Packing Co.	Salem	Wells	.120	.250	"	----
Valley Packing Co.	Salem	Wells	.190	----	"	----
Nebergall Meat Co.	Albany	Wells	.180	----	"	----
Mt. Angel Coop. Creamery	Mt. Angel	Wells	.180	.060	"	----
Western Ore. Packing Co.	Corvallis	Wells	.160	----	"	----
M & S Cannery	Milwaukie	Wells	.080	----	"	----
Deluxe Ice Cream Co.	Salem	Wells	.080	----	"	----
Curley's Dairy	Salem	Wells	.100	.080	None	----
Crater Products	Eugene	Wells	.100	.100	None	----
Pictsweet Foods Inc.	Albany	Wells	.030	----	Undetermined	----
Mayberry Chapman Co.	Eugene	Wells	.040	----	Undetermined	----
Salem Nut Growers	Salem	Wells	.030	----	"	----
Aufranc Cannery	Salem	Wells	.030	----	"	----
Albany Foods, Inc.	Albany	Wells	.020	----	"	----

APPENDIX 9 -- TABLE 19 — INDUSTRIAL WATERWORKS — Page 5

(1)	(2)	(3)	(4)	(5)	(6)	(7)
GROUND WATER (CONT.)						
Food & Kindred Products (Cont.)						
Irish McBroom Meat Co.	Eugene	Wells	.016	----	Undetermined	----
Steen Bros. Slaughterh'se	Salem	Wells	.016	----	"	----
City Ice Works	Salem	Wells	.015	----	"	----
Alpenrose Dairy	Vermont Hills	Wells	.013	----	"	----
Fulton Park Dairy	Vermont Hills	Wells	.015	----	"	----
R.C. Cannon Slaughterh'se	Salem	Wells	.012	----	"	----
Yoder Bros. Slaughterh'se	Hubbard	Wells	.010	----	"	----
Wade Meat Co.	Independence	Wells	.010	----	"	----
Anderson & Son Slaughter	Harrisburg	Wells	.004	----	"	----
Kings Market	McMinnville	Wells	.003	----	"	----
Amity Meat Market	Amity	Wells	.003	----	"	----
Laurel Farms	Portland	Wells	.003	----	"	----
McKenzie Meat Co.	Springfield	Wells	.002	----	"	----
Dukes Custom Killing Plant	Eugene	Wells	.002	----	"	----
Junction City Creamery	Junction City	Wells	.002	----	"	----
Monroe St. Cash Market	Corvallis	Wells	.002	----	"	----
Tualatin Packing Co.	Hillsboro	Wells	.001	----	"	----
Subtotal			13.289	1.270		

APPENDIX 9 -- TABLE 19 -- INDUSTRIAL WATERWORKS -- Page 6

(1)	(2)	(3)	(4)	(5)	(6)	(7)
GROUND WATER (CONT.)						
Textile Mill Products						
Molalla Flax Growers	Canby	Well	.180	----	None	----
Subtotal			.180	0.00		
Paper & Allied Products						
Pacific Roofing Co.	Portland	Well	.720	----	Undetermined	----
Subtotal			.720	0.00		
Chemicals & Allied Products						
Union Carbide & Carbon Co.	Portland	Well	1.150	1.00	Undetermined	----
Subtotal			1.150	1.00		
Miscellaneous						
Oregon Shipyards	Portland	Wells	.180	----	Chlorinated	----
Subtotal			.180	0.00		
TOTAL GROUND WATER			15.519	2.270		
GRAND TOTAL -- ALL WATER			189.289	93.210		

APPENDIX 9 -- TABLE 20

IRRIGATION WATER SUPPLY[1]

Projects	Estimated Irrigable Acreage	Annual Water Requirement Acre-Feet	Source of Water Supply
Proposed Projects			
Cottage Grove	6,600	13,200	Coast Fk. Willamette
Pleasant Hill	1,300	2,600	Middle Fk. "
Eugene	10,700	21,400	Willamette
Springfield	8,800	17,600	McKenzie
Coburg	35,000	70,000	McKenzie
East Long Tom	10,500	21,000	Long Tom
West Long Tom	6,300	12,600	Long Tom
Albany	25,000	50,000	South Santiam
Scio	19,500	39,000	South Santiam
Stayton	14,000	28,000	North Santiam
Salem	113,000	226,000	North Santiam
Willamette Flood Plain	75,000	150,000	Willamette
Brownsville	4,300	8,600	Calapooya
Calapooya	15,400	30,800	Calapooya
Independence	10,400	20,800	Luckiamute
Yamhill	65,800	131,600	Yamhill
Molalla	40,900	81,800	Molalla
Canby	3,270	6,540	Molalla
Clackamas	2,700	5,400	Clackamas
Tualatin	68,600	137,200	Tualatin
Marys River	4,400	8,800	Marys River
Total	541,470	1,082,940	
Existing Projects[2]			
	65,000	130,000	Surface waters
	65,000	130,000	Ground waters
Total	130,000	260,000	

---

[1] Data supplied by Bureau of Reclamation.

[2] Included in Proposed Projects Totals.

APPENDIX 9 -- TABLE 21

HYDROELECTRIC POWER PROJECTS[1]

1948

Name	Owner	Location	Nameplate Rating (KW)
Leaburg	City of Eugene	McKenzie River	6,000
Walterville	City of Eugene	McKenzie River	2,630
Station "B"	Portland General Electric Co.	Willamette Falls	4,890
---	Crown-Willamette Paper Co.	Willamette Falls	3,600
---	Publishers Pulp & Paper Co.	Willamette Falls	1,740
Station "P"	Portland General Electric Co.	Clackamas River	51,000
Station "G"	Portland General Electric Co.	Clackamas River	15,250
Station "M"	Portland General Electric Co.	Clackamas River	14,050
		TOTAL	99,160

Source: Corps of Engineers Columbia River and Tributaries Review Report.

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[1] Includes only projects over 1,000 kilowatts capacity.

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MEMBERS OF THE AUTHORITY
HAROLD WENDEL, Chairman, Portland
BLAINE HALLOCK, Baker
DR. HAROLD M. ERICKSON, Portland
CHAS. E. STRICKLIN, Salem
JOHN C. VEATCH, Portland
E. A. MC PHILLIPS, McMinnville

CURTISS M. EVERTS, JR.
Chief Sanitary Engineer
Secretary

(SEAL)

OREGON STATE SANITARY AUTHORITY

1022 S. W. 11th Avenue
Telephone ATwater 9233
PORTLAND 5, OREGON

December 8, 1950

R. R. Harris, Officer in Charge PHS
Division of Water Pollution Control
Swan Island Building 24
Portland 18, Oregon

RE: WPC-5-34
Willamette River

Dear Mr. Harris:

We were pleased to have the opportunity to review in detail the report prepared by your office on Water Pollution Control Pacific Northwest Drainage Basins, Sub-Basin J, Willamette River Basin.

The only changes or corrections which we thought desirable to suggest were minor in nature. They were discussed recently on the occasion of our conference with Mr. David Howells and, therefore, need not be enumerated in this letter.

This report is undoubtedly the most comprehensive one that has ever been prepared on the subject of pollution control in the Willamette River basin. In our opinion it has been very well written. We are confident that the data and information contained in it will be of considerable value to the program in the future.

Very truly yours,

/s/ Curtiss M. Everts Jr.
CURTISS M. EVERTS, JR.
Secretary and Chief Engineer

KHS*GL

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Address Only The Regional Director
Fish and Wildlife Service
And Refer To
1-RB

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

OFFICE OF REGIONAL DIRECTOR
Swan Island
PORTLAND, OREGON
(18)

Region 1
Washington
Oregon
California
Nevada
Idaho
Montana

RB-Coop.
P.H.S.

May 19, 1950

Officer in Charge, Public Health Service
Division of Water Pollution Control
Swan Island Building 24
Portland 18, Oregon

Dear Sir:

The copy of your report entitled Water Pollution Control for the Willamette Basin, submitted to us for comment with Mr. McGrath's covering letter of April 27, has been reviewed by my staff and is herewith returned. We have been most favorably impressed by the report and wish to commend those responsible for its preparation.

Aside from a number of suggested minor editorial changes, which are noted throughout the report, our wildlife specialists believe that a few more comments on this important resource should be added to the report in discussing the economy of the region. It is realized that the fishery problems are of much greater concern in pollution control, but when such industries as farming and agriculture are discussed, it appears that the wildlife values should also be brought into the picture.

Wildlife resources are particularly valuable in this basin, which supports two-thirds of Oregon's population. The principal mammals involved are deer, beavers, minks, muskrats, and martens. Game birds include ring-necked pheasants, band-tailed pigeons, and various species of quail, grouse, ducks, and geese.

More detailed information on wildlife of the Willamette Basin, along with data on license sales may be found in the Fish and Wildlife Service report on the Willamette Valley Project of the Corps of Engineers. A copy of this report will be furnished your office if so desired.

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The opportunity to review and comment on your report is greatly appreciated.

Very truly yours,

/s/ Leo L. Laythe
Leo L. Laythe
Regional Director

Enclosure

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Regional Office, Region 1
Box 937
Boise, Idaho

Officer in Charge
Public Health Service
Division of Water Pollution Control
Swan Island Building 24
Portland 18, Oregon

Dear Sir:

Enclosed are my comments on the three following Public Health Service subbasin reports:

(1) Subbasin E, Yakima River Basin.

(2) Spokane River Basin - Subbasin D.

(3) Willamette River Basin - Subbasin J.

My comments on your Basin Report have been made the subject of a separate letter which was dispatched to your office on October 17, 1950.

I understand that additional reports are to be made for each of the subbasins covered in your Basin Report. I shall appreciate the opportunity of reviewing each of them as they become available.

I take this opportunity to thank you for your prompt response to my request that a member of your staff meet with us here in Boise to discuss the subbasin reports we have at hand. As a result of the meeting with Mr. McGrath, we have eliminated a number of comments which we would have otherwise been compelled to include here.

With Mr. McGrath's permission, we have retained the preliminary draft of the above reports in our files.

Sincerely yours,

/s/ Lyle Cunningham
Assistant Regional Director

Enclosures 3

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Enclosure No. 3

Comments on Willamette River Basin - Subbasin J.

The report does not evaluate the effects the present Army construction (flood control) program may have in the Willamette Basin relative to the problem of pollution. The construction program is one of considerable size, affecting the stream flows in many parts of the basin. Releases for power, irrigation, downstream users and evacuation of storage space for flood control purposes may have considerable influence on the pollution problems of the basin.

The above comment is submitted solely for the purpose of focusing your attention on this point in the very unlikely event it was overlooked in making the study.

/s/ J. Lyle Cunningham

Assistant Regional Director

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Address Reply to
The Division Engineer
Not to Individuals
NPD VG
Refer to File
No.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DIVISION ENGINEER
NORTH PACIFIC DIVISION
500 Pittock Block
PORTLAND 5, OREGON

NPD 800.224(Willamette Riv.)
Portland Dist. - 1.2C

June 15, 1950

Officer in Charge, PHS
Div. of Water Pollution Control
Swan Island Building 24
Portland 18, Oregon

Dear Sir:

Reference is made to your letter dated April 27, 1950, pertaining to your report on Water Pollution Control for the Willamette Basin and my partial reply dated May 5, 1950.

There is inclosed a letter advising you that no exception is taken to the report findings which may be included in the report as requested.

A number of minor comments have been noted in the returned copy of the report. Other additional minor comments are tabulated on Inclosure 2 herewith. The referenced comments are believed worthy and it is suggested they be given appropriate consideration.

Release of stored water from reservoirs presently constructed, under construction, and authorized for construction in connection with the comprehensive plan for the development of the water resources of Willamette River by the Corps of Engineers would increase the low-water flow at Salem to approximately 260 percent of the present minimum discharge. While dilution from increased flows is recognized as being only a supplement to the treatment of sewage and industrial waste, increased flows of the magnitude possible under the authorized plan of development will undoubtedly permit substantial savings in the cost of construction and operation of sewage and waste treatment plants as far downstream as Oregon City. The beneficial effect of the use of stored water from the dams now completed has already become noticeable and with two additional storage dams under construction and the remainder authorized, the advantages of the dilution from higher low-water flows should become increasingly evident.

Very truly yours,

/s/ O. E. Walsh
O. E. WALSH
Colonel, Corps of Engineers
Division Engineer

3 Incls.
Incl. 1, Report
Incl. 2, Comments
Incl. 3, Cy ltr, NPD 15 June 50

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Address Reply To
The Division Engineer
Not to Individuals

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
OFFICE OF THE DIVISION ENGINEER
NORTH PACIFIC DIVISION
500 Pittock Block
PORTLAND 5, OREGON

NPDVG
Refer to File
No.

NPD 800.224(Willamette Riv.)
Portland Dist. - 1.3C

June 15, 1950

Officer in Charge, PHS
Div. of Water Pollution Control
Swan Island Building 24
Portland 18, Oregon

Dear Sir:

Review of your report on Water Pollution Control for the Willamette Basin submitted by your letter dated April 27, 1950, has been completed by Colonel D. S. Burns, Portland District Engineer and by this office.

No exception is taken to the report findings.

Sincerely yours,

/s/ O. E. Walsh
O. E. WALSH
Colonel, Corps of Engineers
Division Engineer

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UNITED STATES
DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Pacific Region

Portland, Oregon
August 8, 1951

Mr. Robert R. Harris
Senior Sanitary Engineer
Officer in Charge
Public Health Service
Division of Water Pollution Control
Swan Island, Building 24
Portland 18, Oregon

Subject: Report on Water Pollution Control,
Pacific Northwest Drainage Basins-
Subbasin 9, Willamette River Basin

Dear Mr. Harris:

This office has reviewed the report transmitted with your letter of July 19, 1951. It is a well-prepared report on a problem of much concern and only a minor revision is suggested.

On page 57, paragraph 2, it is stated that "these (Willamette) lands are resistant to erosion". Some of the soils in this watershed are quite erodible and it is rather a combination of normally low intensity rainfall and quick recovery by vegetation which makes for less erosion or its evidence.

Although Plate No. 2 "Soil Erosion on Cultivated Lands in the Willamette Basin" is dated February 1949 and is discussed in the text on page 57, it is not clear that the erosion mapped occurred only during the February 1949 storms. It is suggested that a more specific reference between the erosion shown and the date of its occurrence be made.

Yours very truly,

/s/ R. C. Fury

R. C. Fury
Acting Regional Director

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